CONSTRUCTION SAFETY AND PHASING PLANS: GOOD PRACTICES AT AIRPORTS

By

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ABSTRACT

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Airports are complex environments and pose a variety of safety and phasing issues. Construction operations at airports involve significant risk. An important element of the overall airport construction process is the construction safety and phasing plan (CSPP). A CSPP is defined as a document that outlines procedures, coordination, and control of safety issues during construction activity on an airport.

Presently, every airport creates its own Construction Safety and Phasing Plan (CSPP) based on the most recent version of the Advisory Circular on Operational Safety of Airports during construction issued by the Federal Aviation Administration (FAA). Despite the abundance of literature on construction safety, the concept of airport construction safety is not currently widely documented, and the literature related to CSPP in the United States is still limited. Additionally, the airport industry lacks specific construction guidelines and standards in improving the development and implementation of CSPP for airport projects. Therefore, it is important to identify good practices when developing CSPP's which could identify potential safety concerns.

The goal of this research was met by using data collection methods that included an electronic survey of around 100 stakeholders. The survey data was supplemented by conducting seven semi-structured interviews as well as research validation using a case study. Descriptive qualitative analysis was used to analyze the collected data and the results are presented accordingly.

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KEY TO ABBREVIATIONS

- Air Operations Area (AOA): It is the area of the airport used or intended to be used for the landing, takeoff, or surface movement of an aircraft (FAA, 2017).

- Consultant: An airport consultant is an entity which is contracted by the airport and assists the airports by providing various services such as engineering and design.

- Stakeholder: A stakeholder can be a group or a person at an airport that could work directly with the project team or could be the end users of the airport facility (NAS, 2018).

- Certificated Airport: "An airport which has been issued an Airport Operating Certificate by the FAA" (FAA, 2017).

- Federal Aviation Administration (FAA): It is the agency responsible for regulation and supervision of civil aviation in the United States (Skybrary, 2020).

- International Civil Aviation Organization (ICAO): It is an agency operated by the United Nations responsible for managing the standards and procedures of international air transport.

- Airport Operator: It is the individual responsible for management and direction of the airport.

- Tenant: It is the entity within the airport that has an agreement with the airport to conduct business on airport property (Cornell, 2009).

- Safety Plan Compliance Document (SPCD): It is the document presenting the contractor's plan to comply with the CSPP.

- Best practices: These are termed as those practices which "have been implemented and have shown reasonable success in improving performance" (Hinze, 2013).

Chapter 1: Introduction

1.1 Overview

Airports contribute to a productive national economy and are critical for both the national transportation system and international competitiveness (NPIAS, 2019). All airfield operations take place in a complex environment and it is critical to have arrangements that protect the safety and security of everyone involved. A construction activity at an airport may vary from runway extension, resurfacing of a taxiway, construction of a new Air Traffic Control tower, gate areas or updating of facilities. A construction activity at an airport will involve contractors, airport planners, engineers, and inspection personnel. It also includes numerous measures and construction specifications, accompanying construction related equipment on the airfield, detailed measures to alleviate foreign object debris, and so forth (NAS, 2009).

The safety issues at an airfield vary in nature. For example, a simple issue could emerge when debris is found on the runway through a daily inspection. Such an issue can be resolved immediately. The safety issue could also be complex, such as a construction project needing a more detailed analysis (NAS, 2015). Many major changes are presented to an airport by a construction project. It is essential to understand the risks involved during these construction operations and the ways to deal with them.

Aviation safety, the primary airport consideration, becomes paramount during construction operations at the airport. This situation created the need for a Construction Safety and Phasing Plan (CSPP). A CSPP is defined as “a document that outlines procedures, coordination, and control of safety issues during construction activity on an airport” (FAA, 2017). It provides the minimum contractor safety requirements for airport operational safety during construction. It must be

developed for all construction projects funded by the Airport Improvement Program (AIP). In case of non-certificated airports without grant agreements, the use of a CSPP is not mandatory but is considered a best practice (FAA, 2017). The CSPP is developed in accordance with the most recent version of the advisory circular issued by the Federal Aviation Administration (FAA).

CSPP development takes place through the following steps (FAA, 2017):

- Identification of affected areas: This includes the geographic areas at the airport that would be impacted by the construction operations and must be defined by the airport operator.
- Current operation description: The normal operations in each phase of the airport must be identified.
- Allowance for temporary changes to operation: The existing operations should be continued during construction, to the extent possible. The most significant operations need to be prioritized by the airport operator. To ensure the safe operations of aircrafts, phasing of construction activities must be planned. If construction activities do not allow the safe operations of aircrafts, they must be revised accordingly.
- Taking required measures to revise operations: The measures required to safely conduct the construction operation need to be identified after the current conditions are known.
- Managing safety risk: Incorporating safety risk management into the decision-making process.

The CSPP addresses 19 important elements such as coordination, contractor access, foreign object debris, inspection requirements etc. related to safety and phasing of a project (FAA, 2017).

There are many tasks involved in the management of airport construction operations, including the creation of the CSPP. Typically, an airport consultant is responsible for the creation of a CSPP based on their familiarity with the specific airport. According to the CSPP document, the contractor is usually responsible for the safety of their own personnel. The contractor needs to

submit a Safety Plan and Compliance Document (SPCD) 10 days before the preconstruction conference. This is tailored for the specific project in accordance with the FAA AC 150/5370-2G or the most recent version of the advisory circular. The construction activities cannot begin until the SPCD is approved.

1.2 Need Statement

Construction safety and airport construction safety have gained attention in academic literature recently. The FAA recommendations have streamlined the implementation of different airport safety measures such as CSPP. The primary resource for developing a CSPP is to refer to the FAA Advisory Circular 150/5370-2G. Horst and Murray (2014) explored the subject of CSPP and its best practices by studying the CSPP documents across various International Civil Aviation Organization (ICAO) contracting states. The results suggested limited CSPP best practices identified across ICAO states and suggested combining practices from the United States and United Kingdom to form CSPP best practices. Despite the abundance of literature on construction safety, the concept of airport construction safety is not currently widely documented, and the literature related to CSPP in the United States is still limited. There are no standardized and systematic safety training protocols related to construction safety at airports. Additionally, the airport industry lacks specific construction guidelines and standards in improving the development and implementation of CSPP for airport projects. Therefore, it is important to identify current good practices and related tools/processes used when developing CSPP which could potentially improve aviation safety.

1.3 Goal and Objectives

The goal of this study is to explore current good practices at an airport for the creation, implementation, and management of CSPPs. This goal was achieved by meeting the following objectives:

1. Identify key stakeholders involved in the process
2. Document current CSPP practices utilized in the airport construction industry
3. Synthesize good practices of CSPPs

1.4 Research Methodology

A research methodology shown in Figure 1.1 lists the steps in the process to achieve the research objective. The three primary methods employed to accomplish the goals of this research were:

1) an extensive literature review on airport construction safety and the CSPP document,
2) an online survey to get insights of stakeholders on their CSPP,
3) one-on-one interviews with professionals in and around the Michigan region to get an in-depth insight into their CSPPs

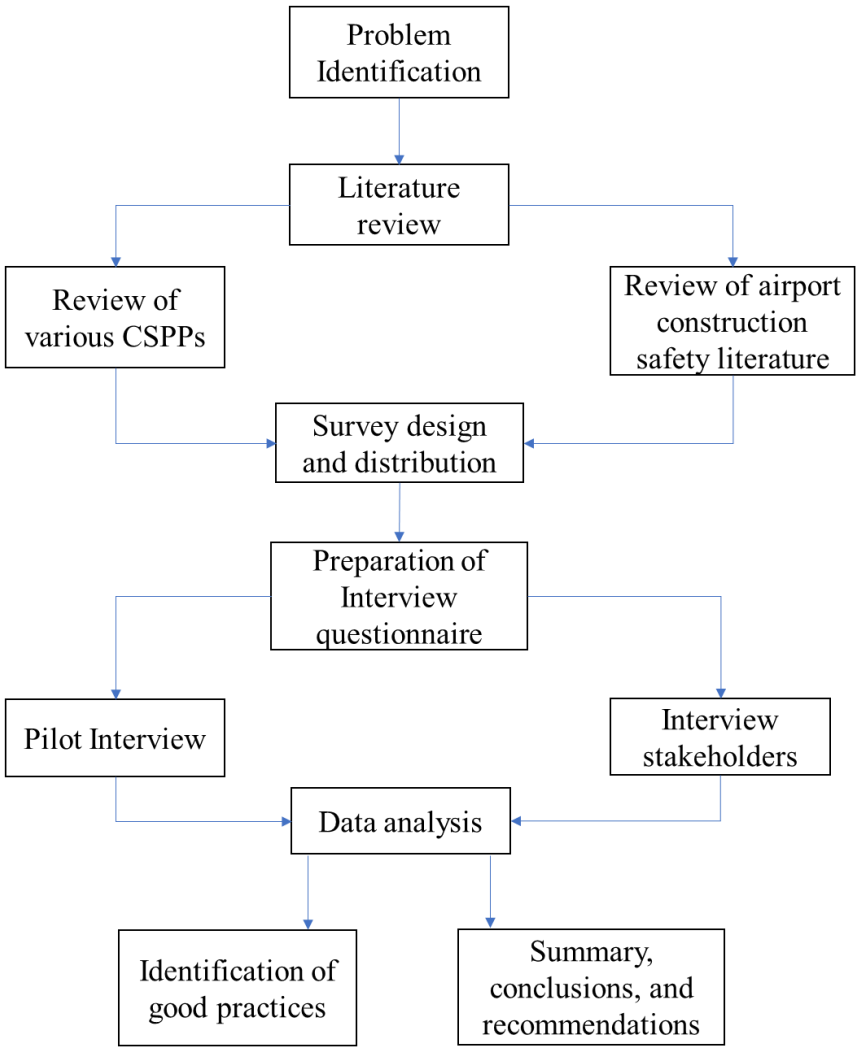

Figure 1.1: Research Methodology

1.5 Thesis Structure

The thesis is divided into five chapters that explain the steps needed to meet the research objectives. Appendices and references are provided at the end of the document. The organization is as follows:

Chapter 1: This chapter offers a basic understanding of the CSPP document, its importance and explains the need for a good practices research in this topic

Chapter 2: This chapter provides an in-depth review of literature on CSPP's and airport construction safety

Chapter 3: This chapter discusses the methods of data collection used for the research

Chapter 4: This chapter discusses the findings obtained from the research methods

Chapter 5: This chapter concludes this thesis by identifying CSPP good practices and provides recommendation for future research

1.6 Chapter Summary

This chapter includes an introduction to the topic. It describes the CSPP document and the steps taken for its creation. It also outlines the research goals, objectives, methodology, and the deliverables to be expected from this thesis.

Chapter 2: Literature Review

2.1 Introduction

The chapter begins with synthesizing literature on airport construction safety. This was done by covering research papers, guidebooks, and other relevant information published by the Airport Cooperative Research Program. Additionally, the chapter summarizes the current practices employed in CSPPs, including a document analysis of CSPPs from 21 different airport projects.

2.2 Airport Construction Safety

Construction operations in airport projects take place in one of the most complex environments and are guided by some of the most stringent safety regulations. Most contractors are unaccustomed to the complex endeavor of conducting construction activities in and around the airport. This endeavor requires coordination with numerous parties and the strict following of a variety of rules and regulations (Weaver, 2017). Airport planners and operators need to carefully consider and assess all hazards and risks associated with the operations. The presence of construction activity and temporary facilities near airport operations increase the risk of various types of hazards. Landing/takeoff overruns, landing undershoots, and landing/takeoff veer-offs consist of most of the mishaps taking place on the runway (NAS, 2011). According to accident statistics from Boeing, 55% of the aircraft accidents in the world from 1959 to 2009 took place during takeoff and landing stages of the flight (Boeing, 2010).

A runway incursion is considered as a major risk during construction operations. Any event at an airport that involves the wrong presence of an aircraft, person, or vehicle on a designated area for takeoff/landing is known as a runway incursion (ICAO, 2007). Airport improvement projects

result in more complex airport layouts that, along with inadequate airport design standards, signage, markings, and lighting, lead to increased risk of a runway incursion (ICAO, 2019).

According to a study on aircraft overruns and undershoots for runway safety areas, the traditional approach to reduce the risk of accidents/incidents in airfields is to expand the runway safety area. One of the issues with this approach is that many airports do not have enough land area to adapt FAA or ICAO standards for runway safety areas. This study also suggested that substantial enhancement to airport operational procedures can be attained by dealing with the operational factors which include the period of runway safety area (RSA) planning and aircraft operations (NAS, 2008).

2.3 Prior Documented Case Studies

Several airfield accidents have been attributed to construction activities. To demonstrate the importance of following CSPP guidelines, two aircraft accidents related to construction operations were reviewed.

Case: Corsair Flight 942 (CBS News, 1999)

This flight was bound from Los Angeles International Airport to Tahiti. The aircraft was carrying 317 passengers and crew members. As the flight headed towards takeoff, it struck two tractor-trailer rigs and a pickup truck at a construction site. One of the aircraft's engine was damaged but no injuries were reported after the incident. The driver of one of the struck vehicles jumped out before the trucks were struck. The accident damaged one jet engine and the right wing of the aircraft and the trucks were shattered.

The area had been under construction for the last few weeks. The aircraft crossed the warning lights and entered the construction area and stopped after the trucks were hit. The pilot in this accident was taxiing on a closed taxiway.

Figure 2.1: Corsair 942 hitting a pickup truck (LAX, 1999)

Figure 2.2: Prior to hitting the green truck, the flight hit this truck

Case: Korean Airlines damaged by collision with contractor's truck (Lexis, 2015)

This case is about a collision that took place on the taxiway of the JFK Airport. A boom truck owned by Tully Construction company was struck by a Boeing 747 cargo airplane owned and operated by Korean Airlines. In this case, there was a failure to close a taxiway for construction activity. Action was brought to court after the aircraft used a taxiway at night after a contractor requested a closure. The contractor did not verify that the taxiway was closed, and the airport proprietor did not notify the tower of the request. The aircraft's wing hit and overturned a construction truck. The truck was parked near the taxiway. This incident injured the truck driver. Under FAA Advisory Circular 1500/5370-2E, Operational Safety on Airports During Construction, the proprietor had a duty to keep the taxiways free from obstructions that could create difficulties for the safe passage of aircraft on the taxiway. The airport's contract with the contractor directed definite safety practices and the airport had the authority to suspend the contractor's operations under the contract to accommodate safety concerns.

The cases presented here show the importance of following the FAA guidelines for the CSPP document. Even the slightest of confusions may lead to catastrophic incidents.

2.4 Advisory Circulars

Advisory circulars are produced by the FAA and contain information to guide institutions and individuals in the aviation industry as well as the public. These circulars are informative in nature, not regulatory. The FAA has published advisory circulars on all kinds of subjects related to aircraft, airmen, air traffic, airfield construction, etc. For CSPP development, the most recent version of Advisory Circular 150/5370-2 (Operations Safety of Airports During Construction) is used. The latest version 150/5370-2G was introduced on December 13, 2017, replacing the 2F version.

The FAA Advisory circular 150/5370-2G defines a CSPP document as a "document that outlines procedures, coordination, and control of safety issues during construction activity on an airport" (FAA,2017). The common components of a CSPP as provided in the Advisory Circular 150/5370-2G are described as follows (FAA, 2017):

- Coordination: This comprises information on the meetings and conferences to be conducted prior to, during, and at the end of the project.
- Phasing: This provides the information on how the project is phased, including the location and duration of every phase of the project. This section also consists of the drawings indicating the safety procedures in the phased areas.
- Areas and Operations Affected by Construction: The construction tasks need to be identified and associated potential safety problems need to be ascertained. The runway and taxiway should be operational, to the greatest extent possible, with safety being the top priority.
- Navigational Aid (NAVAID) Protection: Coordination with the FAA is required before parking vehicles/ storing construction material near NAVAID.
- Contractor Access: The access of contractor personnel to gates, stockpiled materials locations and the operational routes of vehicles and pedestrians are defined in this section. This aims to prevent any unauthorized access to the air operations area.
- Wildlife Management: Several issues such as trash, standing water, tall grass and seeds, poorly maintained fencing and gates, and disruption of wildlife habitats are defined in this section.
- Foreign Object Debris (FOD) Management: FOD must not be kept near active aircraft movement areas. It is considered among the most common dangers of construction projects on the airfield (NAS, 2015).

- Hazardous Materials (HAZMAT) Management: Fuels and hydraulic fuel leaks from the operating vehicles must be contained and cleaned-up.
- Notification of Construction Activities: Airport users and the FAA must be notified of situations adversely disturbing the operational safety of an airport.
- Inspection Requirements: This section includes information on the frequency of inspections. It must be conducted at least daily, although more often if needed.
- Underground Utilities: This includes the information for detecting and protecting underground utilities, cables, wire, and pipes in excavation areas.
- Penalties: The penalty provisions for noncompliance with the safety plans are detailed in this section.
- Special Conditions: Situations here may include low visibility, snow removal, aircraft accidents, and other events needing suspension of work.
- Runway and Taxiway Visual Aids: The areas in which aircraft movement takes place need to be visibly separated from construction areas. The NAVAIDS must be clearly visible to the pilots. This section includes information on the runway/ taxiway markings, lighting and visual NAVAIDS, and existing/temporary signs.
- Marking and Signs for Access Routes: This comprises information on pavement markings and signs for construction personnel.
- Hazard marking, lighting, and signing: These signages serve to stop airline pilots from entering areas that are closed to aircrafts, as well as stop construction personnel from entering areas open to aircrafts. This section also includes information on barricades, lights, and air operations areas.

- Work Zone lighting for nighttime construction: When construction is to be performed at nighttime, there must be adequate illumination in the work area.
- Protection of runway and taxiway safety areas: There are limitations on the height of equipment and stockpiled materials to protect these areas. This section includes information on runway safety areas, taxiway safety areas, excavation, erosion control, object free zones and other limitations on construction.
- Other limitations on construction: This may include other kinds of restrictions such as restrictions on crane height, day/night restrictions, areas that cannot be worked at simultaneously, winter construction etc.

Additionally, there are other construction related advisory circulars, such as:

- AC 150/5370-12, covers guidance for quality management for airport construction projects
- AC 150/5210-5, covers the painting, marking, and lighting of vehicles used at an airport
- AC 150/5210-20, provides information on ground vehicle operations at airports
- AC 150/5320-15 includes management of airport industrial waste. (HAZMAT)
- AC 150/5200-18: Airport Safety Self Inspection, covers daily inspection requirements

2.5 Prior Construction Safety Research

Research related to construction safety dates to 1926 (Almstead, 1926). However, it was not until the early 2000s that research related to safety began to flourish. Figure 2.1 shows the number of safety publications from 1926 until March 2020. As can be seen, the last few decades have brought high interest in research related to construction safety.

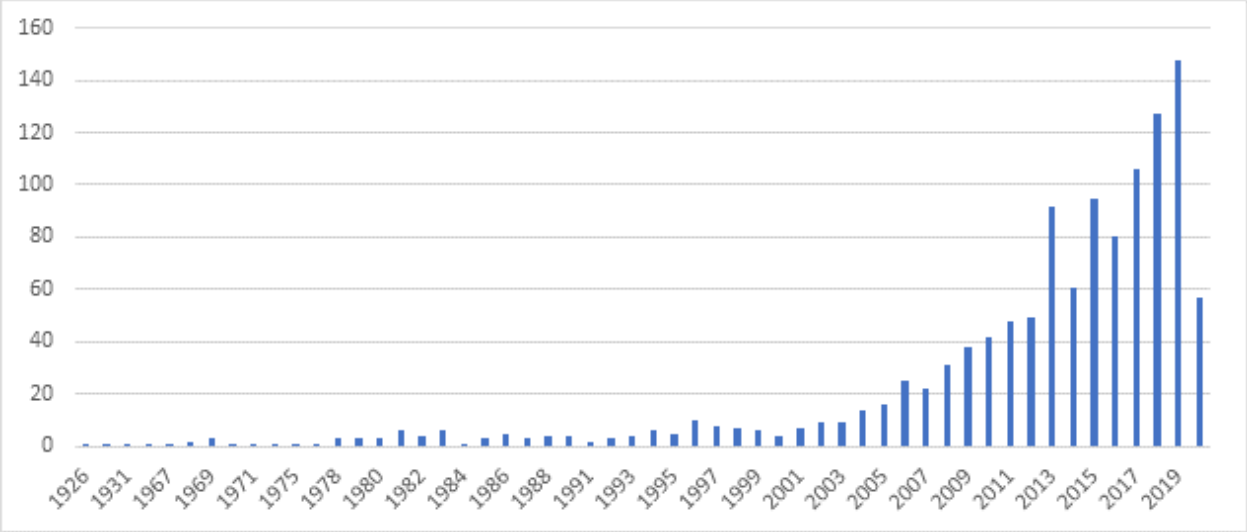

Figure 2.3: Construction safety publications over time

The Construction Industry Institute (CII) found five high-impact safety techniques for construction in a research on construction safety. These were referred to as zero-injury techniques (Construction Industry Institute 1993). Findley and Smith (2004) found that companies reporting better safety performance also reported a high number of safety management practices. Mitropoulos et al. (2005) studied the factors causing unsafe conditions and proposed a model for reducing task unpredictability to reduce the likelihood of accidents. Hallowell and Gambatese (2010) provided a risk-based model framework for construction safety management to improve safety management in construction.

Additionally, related to airport construction safety, Glazner et al (1998) offered the opportunity to find the risk factors for injury among workers at Denver International Airport (DIA). It was found that the rate of injuries was highest in the initial year of construction, and primarily among elder workers. There was a lack of correlation between rate of injuries in contracts belonging to the same company. This led to the conclusion that an effective way to prevent injuries would be to target safety resources at the contractual level. Wiegmann and Shappell (2003) developed a framework to examine the human errors in airfield accidents. This framework was based on the Swiss Cheese

accident causation model by James Reason. Khalafallah and Reyes (2006) conducted a research on minimizing construction related hazards in airport expansion projects. An optimization model with a multi objective function was created for construction site layout planning at airports to satisfy all operational safety constraints by the FAA. The model was made to be capable of reducing construction hazards and optimizing the cost of site layouts.

Horst and Murray (2014) explored the subject of CSPP and its best practices by studying the CSPP document across various ICAO contracting states. It was found that the creation of all CSPPs share a common design and access/consult and mitigate process framework. Figure 2.2 illustrates the development framework.

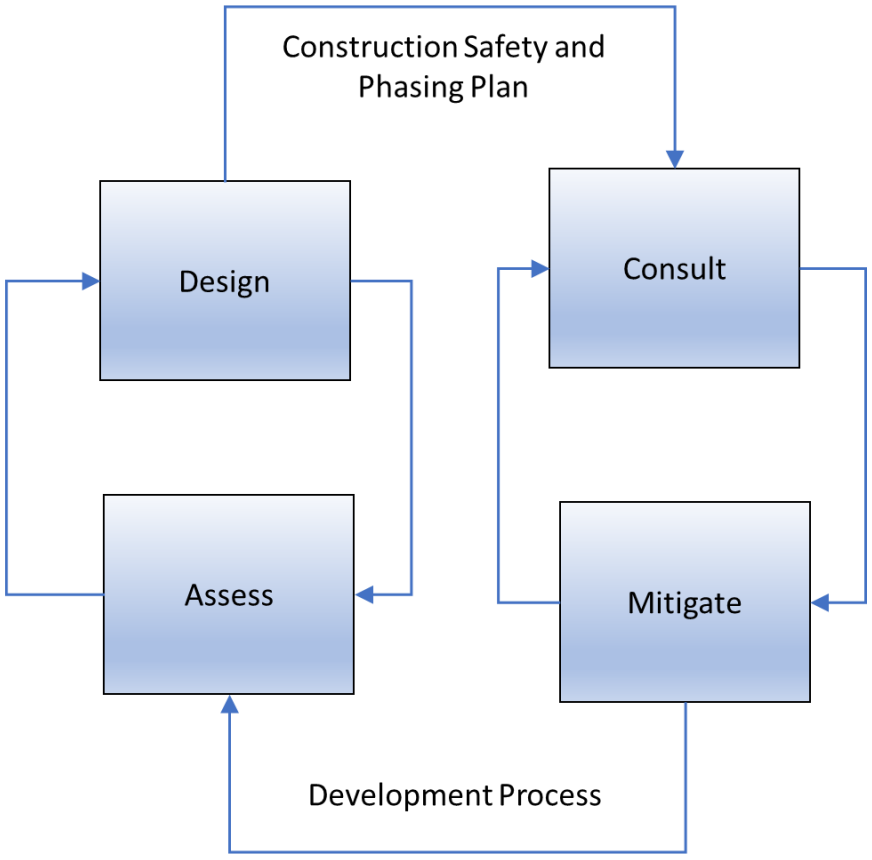

Figure 2.4: The CSPP Development Process Framework (Horst and Murray, 2014)

The results showed that a combination of practices from the United Kingdom and the United States would form the best practices for CSPP. This study suggested the aviation industry for

international collaboration to extend the use of CSPP best practices. To the best of the researcher's knowledge, despite the abundance of literature on construction safety, the concept of airport construction safety is not widely documented, and the literature related to CSPP is limited.

2.6 Construction Safety and Phasing Plans Document Analysis

Twenty-one CSPP documents from various FAA regions in the United States were reviewed. These documents were found through an online search. The review was done to understand the overall process and, compare the documents from different projects based on parameters such as the size of the document, their scope of works, the checklists provided in the document, etc.

The following Table 2.1 provides information on the 21 CSPP documents and Figure 2.6 shows the distribution of types of work in the reviewed CSPPs.

Table 2.1: CSPP document information

#	Airport	Prepared By	Type of Work
1	Fort Lauderdale - Hollywood International Airport	Consultant	Terminal expansion/gate replacement
2	St. Pete - Clearwater International Airport	Consultant	Perimeter fencing/gates
3	Honolulu International Airport	Consultant	Taxiway rehabilitation
4	Safford Regional Airport	Consultant	Taxiway rehabilitation
5	George Bush Intercontinental Airport, Houston	Consultant	Sanitary sewer lines
6	Yakima Air Terminal	Consultant	Taxiway rehabilitation

Table 2.1 (cont'd)

7	San Bernardino International Airport Authority	Not available	Taxiway rehabilitation
8	Oakland International Airport	Consultant	Runway rehabilitation
9	Nogales International Airport	Consultant	Apron rehabilitation
10	Sioux Falls Regional Airport	Consultant	Runway rehabilitation
11	Spokane International Airport	Consultant	Taxiway rehabilitation
12	St. Louis Lambert International Airport	Consultant	Taxiway rehabilitation
13	Gerald R. Ford International Airport	Consultant	Taxiway/apron rehabilitation
14	Denver International Airport	Consultant	Runway rehabilitation
15	Jefferson County International Airport	Consultant	Automated Weather Observation System Installation
16	Los Angeles International Airport	Consultant	Hangar demolition
17	O'Hare International Airport	Consultant	Runway rehabilitation
18	Sarasota Manatee Airport	Airport	Passenger boarding bridges replacement
19	Yakima Air Terminal	Consultant	Taxiway rehabilitation
20	Yuma International Airport	Consultant	Apron rehabilitation
21	Blue Grass Airport	Consultant	Taxiway rehabilitation

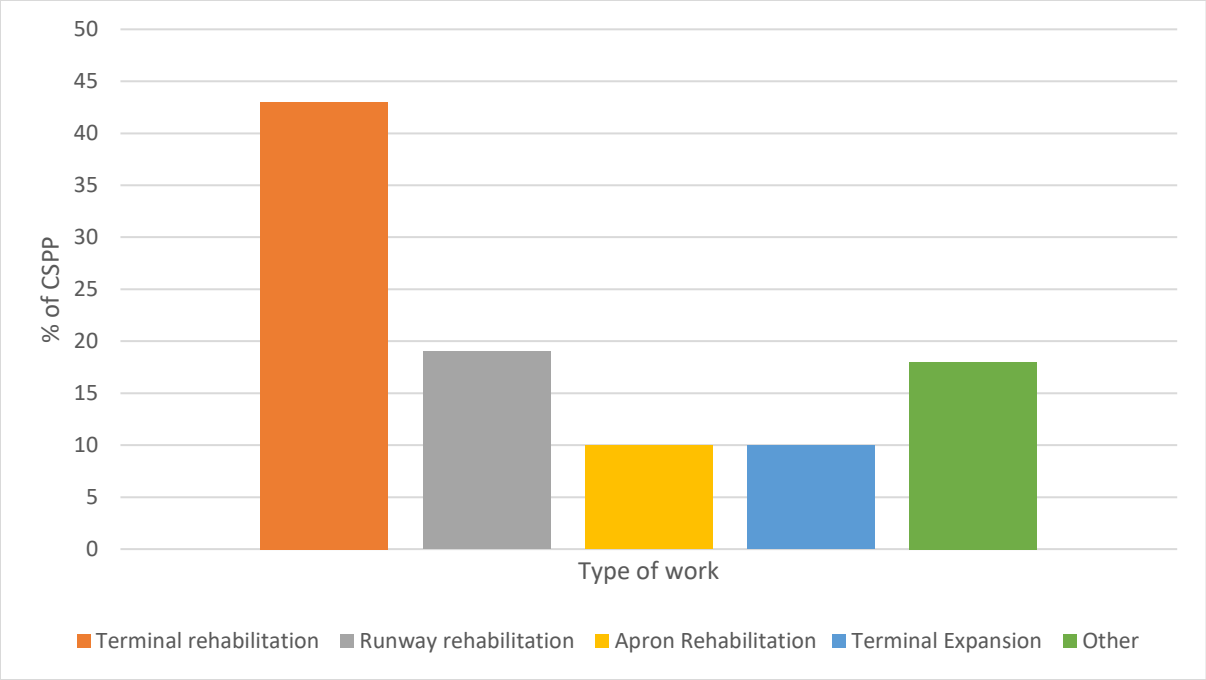

Figure 2.5: Distribution of type of CSPP work

A few key observations after the analysis of the various CSPPs included:

- A CSPP is developed for every construction activity impacting aircraft operations for Part 139 airports.
- The document size varied depending on the scope of the project. Larger scope of works generally consisted of a larger document for the plan, comprising of more detailed elements from FAA guidelines and how they will be complied.
- All the analyzed CSPPs contained each provision provided on the FAA advisory circular on Operational Safety of Airports During Construction.
- About 40% of the CSPP's contained a Safety Plan Checklist in its appendix. One of the safety plan checklists can be found in Appendix A of the thesis. This checklist covers several general safety and general construction items related to the plan.
- Every CSPP has provision for safety inspection at least on a daily basis

- Some airports used a more generalized template of the CSPP document while others used a more custom and airport specific CSPP.
- Ninety percent of the CSPP documents were created by a consultant. In some cases, they were developed internally by the airport.
- The phasing element was the most detailed section in most CSPP documents.
- Forty percent of the CSPPs provided contact information of key airport stakeholders involved in the project.
- All CSPPs provide detailed airport plans with phases marked on them.
- Training is highly emphasized for ground vehicle operations in most of the CSPPs.
- Some of the CSPP documents provided important contract dates such as notice to proceed and project completion dates.
- All CSPP documents requested a safety plan compliance document (SPCD) document from the contractor.

2.7 Summary

The literature review was presented in this chapter. This included a combination of airport construction safety literature and a CSPP document review. It was found that despite the existence of extensive literature on general construction safety, the literature on airport construction safety is still limited in academic literature. The document analysis helped the researcher understand the various CSPP components and helped in deciding the research methods.

Chapter 3: Research Methodology

3.1 Introduction

This chapter presents the research approach taken to achieve the objectives. It briefly summarizes the research objectives and illustrates different steps taken by the researcher. The literature review is not discussed here in detail, as it was presented in Chapter 2. The research approach is a combination of online survey, semi- structured interviews, and one in-depth case study. The chapter illustrates tasks to design the survey instrument, sample selection, and survey delivery. Similarly, the semi-structured interviews are discussed. Finally, an in-depth case study protocol is presented.

3.2 Research Goal and Objectives

The goal of this study is to explore good practices for creating, implementing, and managing CSPPs for airports. To achieve this goal, the following objectives were formalized:

1. Identify key stakeholders involved in the process
2. Document current CSPP practices utilized in the airport construction industry
3. Synthesize good practices of CSPPs

3.3 Research Approach

This research is exploratory in nature and follows a qualitative approach. A literature review was used to identify potential questions needed for the data collection phase. Qualitative methods of an online survey, semi-structured interviews and a case-study were used for collection of data. Further, descriptive analysis was used to analyze the collected data.

3.4 Research Methodology

Figure 3.1 illustrates the different tasks conducted to fulfil the objectives of this research.

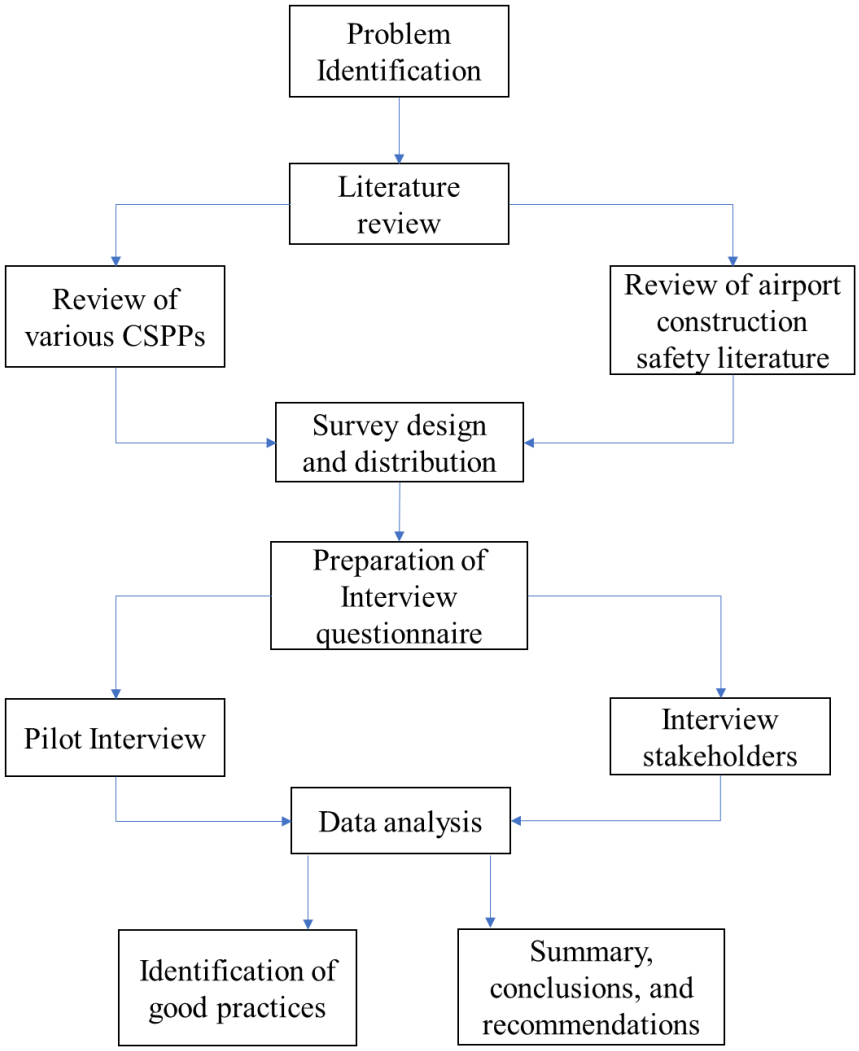

Figure 3.1: Research Methodology

There has been limited research on airport construction safety, and none directly related to CSPP in the United States. The primary resource for developing a CSPP is to refer to the FAA Advisory Circular 150/5370-2G. Additionally, there exists no standardized and systematic safety training related to construction safety at airports. These findings led to the creation of the problem statement for this research. Once the problem was identified, the study was commenced by a literature review into the topic.

The literature review was done in two categories. The first category covered the current practices being employed in CSPPs. This was done after reviewing the CSPPs of 26 different airports, the numerous versions of FAA advisory circulars, and relevant CSPP documents. The second category covered literature on airport construction safety. This was done by covering research papers, guidebooks, and additional relevant information on this topic.

The literature review aided in the process of defining the methods of data collection. The findings from the literature review led to the formation of questions for the online survey. The survey was distributed to relevant stakeholders across the United States. After the survey was completed, the interview protocol was created with the help of results from the survey. The protocol was tested through a pilot interview and this led to the creation of the final interview protocol, which was used to interview stakeholders in the Michigan region. The interview phase also consisted of a case study at a Michigan airport. After data was collected, it was analyzed using qualitative analysis and concluded by identification of good practices. Finally, recommendations were provided for future research on this topic.

3.5 Survey

Because of the nature of the research problem, a survey method was selected as the initial approach/tool for data collection because it was deemed appropriate for cost and expediency. A research survey is defined as a method for collecting information from a selected group of people using a standardized questionnaire (Saris & Gallhofer, 2007). Surveys are inexpensive to develop and distribute and they provide a great option for arriving at conclusions by allowing a range of questions on a topic. The use of online surveys as a data collection tool has been significant in the last decade. According to Dillman (2000), email, Internet and electronic survey methods provide dramatic improvement in data collection efficiency.

Due to the large sample requirements for this study, a survey was deemed as the best choice. The survey also provided the advantage of standardization of questions. The MSU subscription of Qualtrics was used to administer the initial survey. Qualtrics is a web-based tool for conducting survey research. The questions identified in the literature review influenced the survey design and piloting.

3.5.1 Sample Selection

Survey population selection is vital to the validity of any research results. Due to the exploratory nature of the research, the survey population was initially identified based on involvement in some aspect of the overall CSPP process. The selected participants were expected to have competent knowledge in airport construction and were involved in the CSPP development/implementation process. The survey purpose was to collect information from as many U.S. stakeholders as possible. To increase the response rates, the questionnaire was designed to be concise and easy to understand, and frequent reminders were sent out (Kelley et al, 2003). A list of potential participants was composed from the following groups:

- Airport Engineers, Operators, and Managers: These contacts were found through various sources, including airport and FAA websites, online directory searches and contract documents. This list included about 800 participants for the survey distribution list.
- Consultants: Most of the consultants were found through the Airport Consultant Council directory. They were also found through CSPP documents in the document analysis phase of the research. This list provided contact information for around 550 participants.
- Contractors: The contractors were identified through bid documents related to airport construction and the websites of the contractors undertaking airport construction projects. From the search, a list of 250 contact emails was found for contractor personnel.

- FAA personnel: The FAA website includes a list of FAA personnel divided by the different regions. The emails from each FAA region list were extracted and the list included about 500 FAA personnel.

A snowballing methodology was adapted as we asked potential participants to forward the invitation to any potential stakeholders in their contact list that could contribute to the study. Additionally, the invitation was posted on multiple professional organizations' LinkedIn profiles. The intent was to capture any stakeholder that had not been identified previously. Although it is hard to identify the number of potential participants that received the email, 2,351 participants clicked on the link. Only 127 participants started the survey, and this number served as the initial population in calculating the response rate of the survey.

3.5.2 Survey Instrument

The survey was developed into six sections. Table 3.1 illustrates these categories of questions and the information sought from them. The first section is related to the demographics of the participants, who were asked to identify their profession, their FAA region, and their airport International Air Transportation Association (IATA) code. The next section asked participants to identify external and internal stakeholders participating in the development, management, and controlling of CSPPs, as well as highlight their involvements in the process.

Table 3.1: Summary of Survey Design

Category of question	Information sought
Participant Information	Job title, FAA region
Stakeholder Identification	Individuals involved in the CSPP process
Impact on CSPP	Factors that impact CSPP development/implementation
Designer Identification	Individuals involved with CSPP creation
Best Practices	Practices that improve the creation and implementation of CSPP
CSPP and Contact Information	Information on their recent CSPP and contact information for an interview

The third section inquired about the impact of external events on CSPP development/implementation, such as the impact of major events and delivery methods on CSPP. The fourth section asked the participant questions related to the creation of CSPP. The interest here was to find out who created the CSPP document and why the person/company was chosen. The fifth section focused on identification of practices. This section asked the participants about the best and most inefficient practices they have encountered while working on a CSPP. Participants were also asked on whether they had a checklist in place for creating and implementing a CSPP. The final section asked the participants about their contact information for an interview in the future. Participants were provided with the option to provide their email address if they were interested in an interview.

Most of the survey was designed to include open-ended questions, which allows the respondent to express an opinion without being influenced by the researcher (Foddy, 1993). Twenty-one questions were prepared for the survey to achieve the research objective. The developed survey was programmed into Qualtrics and validated by sending it to two potential participants with strong ties to the researcher. In addition to completing the survey, the participants were asked to

provide feedback on the survey's usability, easiness, and usefulness. This step yielded some recommendations that resulted in modifying, eliminating, and rewriting some of the questions.

3.5.3 Data Collection

Once the survey was validated, it was submitted to the Michigan State University Human Research Protection Program (HRPP) for approval. The research was approved for distribution on March 4, 2019. Appendix B presents the Institutional Review Board (IRB) approval letter for this research. The survey was sent to potential participants to introduce them to the research, explain the research objectives, and invite them to participate via the Qualtrics link. A participant consent form was included in the first page of the survey. The consent form and survey questions are attached as Appendix D. The initial email invitation was sent in March 2019 and bi-weekly reminders were sent until April 2019. Table 3.2 illustrates the geographical distribution of the responses by FAA regions.

Table 3.2: Geographical distribution of survey responses

Location	**Number of Responses**
Alaskan	1
Central	2
Eastern	6
Great Lakes	16
New England	4
Northwest Mountain	7
Southern	13
Southwest	2
Western Pacific	8

As indicated in the table, all airport regions were represented in the survey responses. The regions represented were: Alaskan, Central (IA, KS, MO, NE), Eastern (DC, DE, MD, NJ, NY, PA, VA, WV), Great Lakes (IL, IN, MI, MN, ND, OH, SD, WI), New England (CT, ME, MA, NH, RI,

VT), Northwest Mountain (CO, ID, MT, OR, UT, WA, WY), Southern (AL, FL, GA, KY, MS, NC, PR, SC, TN, VI), Southwest (AR, LA, NM, OK, TX), and Western Pacific (AZ, CA, HI, NV, GU, AS, MH). The survey was sent out to 2,351 participants across the United States. Of those, 127 participants started the survey but only 99 complete responses were received.

The responses obtained from Qualtrics were analyzed using descriptive analysis. Qualtrics provided a statistical module to analyze the collected data. It was used to aggregate the data collected during the survey phase. The most frequent responses were pooled together to indicate a strong correlation of those practices.

3.6 Interviews

The next data collection phase for this research was to conduct interviews. The interview method was chosen for a more in-depth exploration of the topic. The interviews were semi-structured to allow the interviewer and/or interviewee to diverge to pursue an idea or response in more detail (Britten, 1999).

3.6.1 Sample Selection

The results from the survey presented the key stakeholders involved with the CSPP development and implementation. This helped with the process of sample selection for the interview process. The area of distribution was limited to Michigan due to time and resource constraint in the research. A list of potential participants for the interview was composed from the following groups:

- Airport Engineers, Operators and Managers: These contacts were found through various sources including airport websites, online directory searches, and contract documents in Michigan. This list was comprised of about 30 participants for the interview protocol distribution list.

- Consultants – Most of the consultants were found through the Airport Consultant Council directory. A filter for the search was set to Michigan to limit the number for distribution. This list provided contact information for around 20 participants.
- Contractors – The contractors were identified through bid documents related to airport construction and the websites of the contractors undertaking airport construction projects. This online search did not yield many contacts and only five potential contact emails were found for contractor personnel.

The interview invitation and protocol were sent to 60 stakeholders in Michigan. Seven stakeholders agreed to be interviewed.

3.6.2 Interview Instrument

A researcher's interview protocol is an instrument of inquiry - asking questions for specific information related to the aims of a study (Patton, 2015) as well as an instrument for conversation about a particular topic (e.g., someone's life or certain ideas and experiences). The interview protocol framework was comprised of four-phases (Castillo-Montoya, 2015):

- Phase 1: Ensuring interview questions align with research questions
- Phase 2: Constructing an inquiry-based conversation
- Phase 3: Receiving feedback on interview protocols
- Phase 4: Piloting the interview protocol

Protocol creation was initiated after analyzing the survey data, which was observed to determine questions that had already been answered. Based on this, the researcher determined the questions that needed more validation, and additional questions were framed that could help satisfy the research objectives. This process led to the creation of the interview protocol, which was made to

align with the primary research questions. The initial protocol consisted of thirteen open-ended questions. Table 3.2 illustrates these categories of questions and the information sought from them. The first section was related to the interviewee background. The participants were asked about their experience with CSPPs and how their roles were related to them. The second section inquired about the strategies, technologies, and checklists that airports/companies have in place to aid the process of CSPPs. The final category of questions asked the primary research question. The participants were asked about the best practices and most inefficient practices they have encountered while working on a CSPP.

Table 3.3: Interview questions category

Category of question	**Information sought**
Interviewee Background	Experience of the stakeholder and involvement with the CSPP document
Resource Information	Strategies, technologies, checklists in place at the airport/company
Best Practices and Most Inefficient Practices	Practices that improve and practices that make the overall process inefficient

Initially, the interview invitation was distributed to a limited number of Michigan stakeholders who provided their contact information in the survey. This was used for conducting a pilot interview for the research. A pilot interview is considered an essential part of the interview process. For the current study, the pilot interview gave the researcher a realistic sense of the duration of the interview and whether participants could understand and answer the specified questions. It also helped the researcher to understand the questions that were more important and ones that needed

to be removed or modified. The pilot interview also helped to ensure construct validity in the research.

The protocol was reviewed and approved by the Michigan State University HRPP before conducting the pilot interview. Based on the pilot interview, the protocol was modified. The pilot interview participants provided feedback on the protocol. Few questions were removed/modified based on feedback and information obtained from the detailed pilot interviews. This process led to the creation of the final interview protocol, which is attached as Appendix E.

3.6.3 Data Collection

Once the final interview protocol was prepared, emails were sent out to the stakeholders. Interview instructions were sent to each interviewee via email before the interview to ensure that the interviewee understood each question. The email also included a consent form explaining their consent to participate in the research. The interview protocol was sent to potential participants introducing them to the research, explaining the research objectives, and inviting them to participate. The different methods included face-to-face, video call, and telephone interviews, and the participants could choose based on their wishes. The interview was expected to take 30-40 minutes. A total of 60 emails were sent out from June to September 2019. Interview data was analyzed on a case by case basis. The results from each interview were interpreted as they related to the FAA Advisory Circular, survey results, and standard airport construction practices. The answers for the interview questions were summarized and presented in the findings.

3.7 Research Validation

To validate the results of the aforementioned surveys and interviews, a case study approach was utilized. Case studies are an empirical enquiry that investigates a contemporary phenomenon (the case), in its real-world context (Yin, 2014). A single case study approach was selected to allow the

investigator to understand the context surrounding the development, management, and implementation of a CSPP. A small hub airport was chosen for the case study because of proximity and personnel availability. The project scope of work included terminal apron reconstruction, rehabilitation of taxiway pavement, and installation of a new drainage system. The project, which was funded by the FAA, was divided into seven different phases to minimize impact on airline operation. The interviews and data validation were accomplished in two visits.

During the first visit, a field tour was arranged to familiarize the researcher with the project. The planning director and the engineering manager (owner's stakeholders) at the airport were interviewed for about 45 minutes each. The interviews were focused on observing current site practices and discussing research-identified best practices with staff. The second visit was scheduled a few months later and included attending a stakeholder meeting for an upcoming gate addition project at the airport. The scope of work was focused on adding eight terminal gates and new amenities to a concourse. The project had a Construction Management at Risk delivery method. Stakeholders involved in the meeting included the airport planning team, project architects, and project managers representing the contractors and the consultant. Airlines were not involved in this meeting, as it was a preliminary discussion with regards to the schedule. The meeting lasted for a duration of an hour and a half. The primary points of discussion in the meeting were the procurement of materials and the planned phasing of the project. The meeting helped in observing the collaboration between stakeholders before the initiation of a project involving a CSPP.

3.8 Summary

In this chapter, the research methods were presented. This included a combination of an online survey, semi-structured interviews and research validation using a case study. Due to the

exploratory nature of research and large sample requirements, an online survey was initially chosen for collecting data. This was followed by conducting semi-structured interviews for an in-depth exploration into the topic. Finally, a case study was conducted to validate the research findings.

Chapter 4: Data Analysis

4.1 Introduction

This chapter deals with the data analysis and its findings. This is divided into three sections for survey, interview, and research validation. All the findings presented in this chapter are aggregated in Chapter 5 to present the good practices of CSPP development, management, and implementation.

4.2 Survey Findings

As discussed in Chapter 3, the survey questions were grouped into five categories to explore airport good practices for creating, implementing, and managing CSPPs. Table 4.1 illustrates the different categories of questions and the information sought from the collected data. The following sections will present the findings of the survey and highlight the good practices identified.

Table 4.1: Survey question information

Category of question	**Information sought**
Participant Information	Job title, FAA region
Stakeholder Identification	Individuals involved in the CSPP process
Impact on CSPP	Factors that impact CSPP development/implementation
Designer Identification	Individuals involved with CSPP creation
Best Practices	Practices that improve CSPP creation and implementation

4.2.1 Response Rate

Initially, 2,351 total email invitations were sent via Qualtrics. Of those, 127 invitees started the survey and 99 responders completed the survey. A response rate of 30% was achieved, which is comparable with similar survey questionnaires. Additionally, 12 responders completed the survey via the anonymous link.

4.2.2 Participant Information

Fig 4.1 shows the percentage distribution of participant information obtained from the survey.

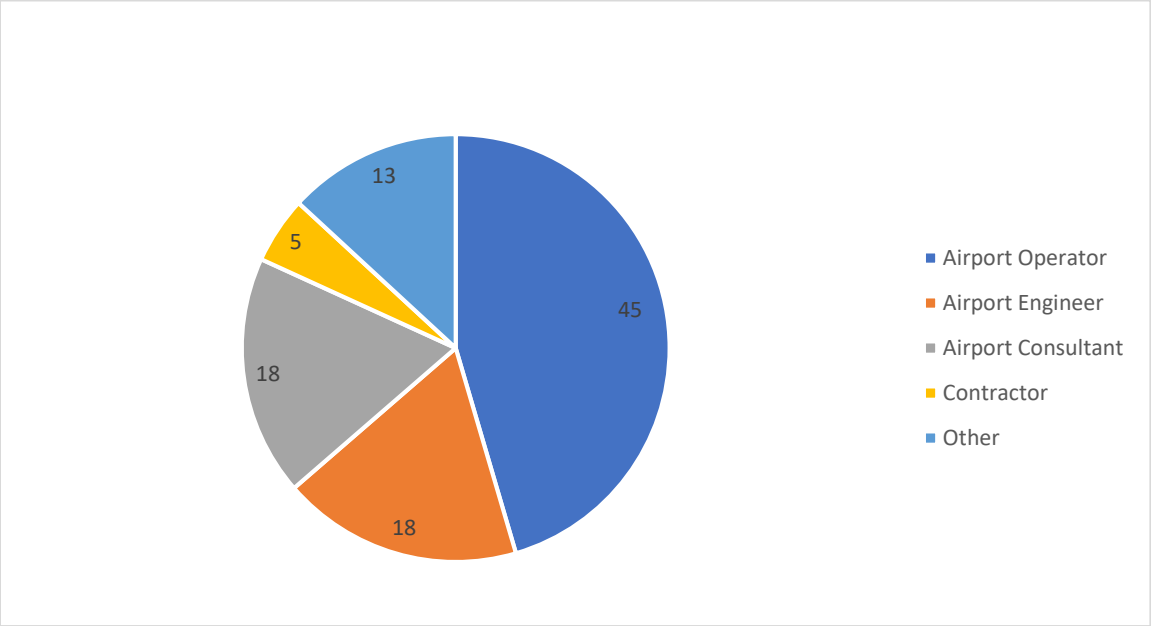

Figure 4.1: Distribution of responses for stakeholder information

Airport operators were the highest rate with 45% representation and contractors were the lowest with 5% representation. Other professions included airport certification safety inspector (ACSI), airport town managers, flight instructors, chief development officers, airport safety managers, and FAA program managers. Although most responses were obtained from the FAA Great Lakes region, participants represented all FAA regions as presented in Fig 4.2.

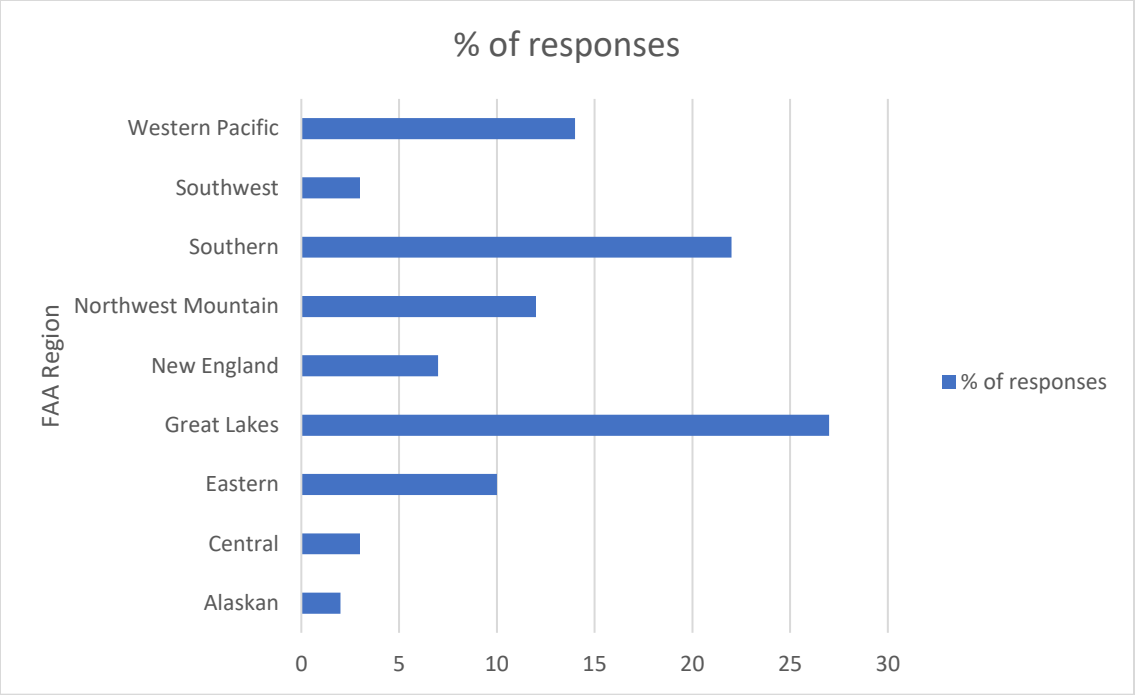

Figure 4.2: Participant response percent by FAA region

4.2.3 Number of CSPP projects reviewed/implemented in the past year

The participants were then asked about the number of airport projects they have worked involving a CSPP. Most of the survey participants had worked on one or more projects within the last year. This was seen in 80% of the responses. Their involvement ranged from creating, implementing, and reviewing CSPPs.

4.2.4 Party responsible for developing CSPP

Sixty percent (60%) of the participants responded that a CSPP was developed by a consultant, while 25% reported that the contractor was responsible for the development of the plan. Only 10% of the respondents reported that it was developed by the airport engineer. Some also claimed it to be a collaborative effort between the consultant and engineer. Fig 4.3 shows the distribution of responses regarding the party responsible for developing a CSPP.

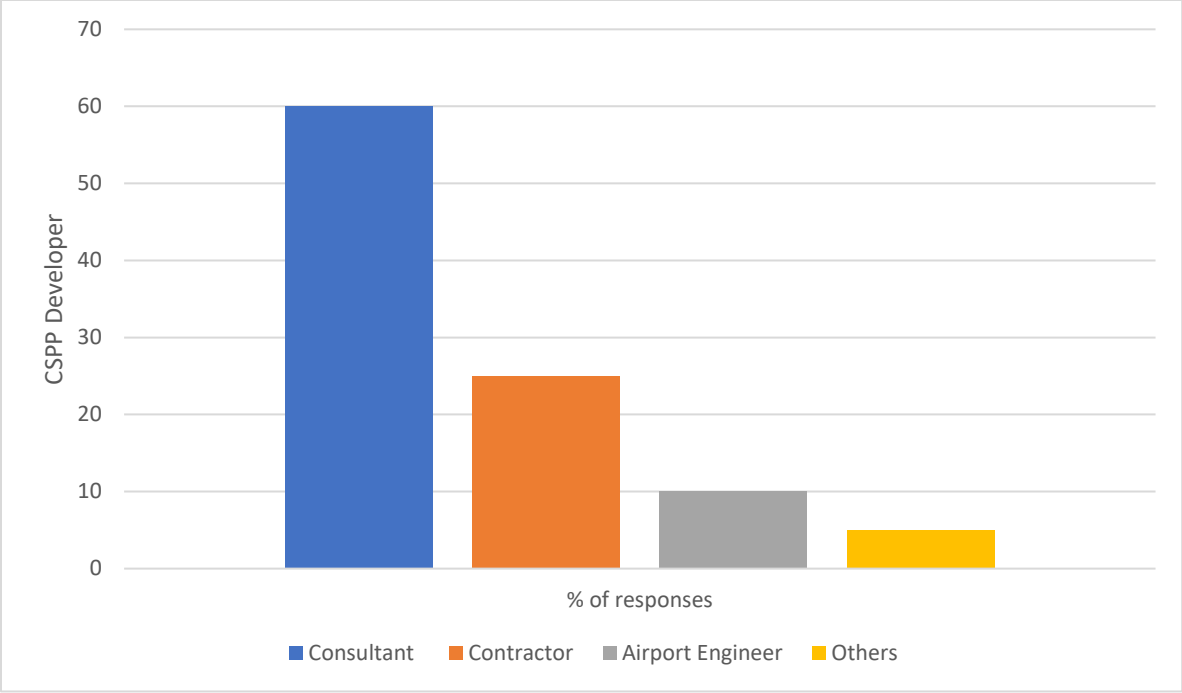

Figure 4.3: Distribution of responses for party responsible for developing CSPP

With respect to the rationale for CSPP creation, most respondents (70%) stated that the rationale for selecting the person or organization was their familiarity with the specific airport and experience with CSPPs. Twenty percent (20%) responded that it was a contractual obligation, while 10% said it was due to a responsibility to the owner. One response noted that the consultant in charge of designing the project usually has the overall picture of safety requirements and construction phasing. However, it is up to the contractor to outline the exact details on how they will comply with certain safety aspects in the CSPP process through the generation of a Safety Plan and Compliance Document (SPCD).

4.2.5 External and Internal Stakeholders

When determining external stakeholders involved in the creation of a CSPP, most responses included the FAA technical operations staff, airport users, contractors, state department of

transportation (DOT), air traffic control (ATC) personnel, and airlines. A few sample responses included:

"*Airlines (closures impact their loads and aircraft suitability), GA and corporate users (need access to the field), FAA air traffic control (need to know what is happening, also provide feedback to minimize operational disruption), FAA technical operations staff (need to know what NAVAIDS may be impacted, have to shut them down and start them up), sometimes general public (if closures impact seat availability, or occur in public areas, such as contractor haul routes that impact terminal access roadways or parking)"*

"Air traffic control tower and airport users. The tower is consulted for impacts to closures and what phasing would work best for them. The airport users are also consulted about closures to determine impacts to their business and if there is an alternative that would better suit them that is also acceptable to the airport."

In the case of internal stakeholders, the responses claim that internal stakeholders were the owner/airport, airport operations personal, airport manager, project manager, designated safety team, airport tenants, and ATC tower personnel. Sample responses included:

"The Airport administration ensures creation of plan and that it follows FAA guidelines/requirements, operations receiving the plan to be able to inspect/enforce it, the field maintenance department knows plan elements and how construction would impact their daily and seasonal work (i.e. grass cutting and snow removal in closed areas)."

"Air Traffic Control Tower - NAVAID closures, flight control Fire Department - coordination on emergency routes to ensure taxiway's/runways are not closed that will prevent them from

responding. Police Department / TSA - coordination required on all Part 139 airports to make sure security is upheld and an adequate badging process is established."

4.2.6 Impact of delivery method on CSPP

When asked whether the CSPP development method would change by changing the delivery method, the opinion was too varied. Fifty percent (50%) responded that it will not change with the delivery method, 40% of the respondents claimed that it will change with it, while 10% were not sure of the response or did not have experience working with a different delivery method. The following sample responses stated:

"Typically, a work phasing plan has been outlined by the engineer prior to release of the bid documents. These phasing plans were assembled with the input/direction from operations and the FAA. The phases are made to have the least possible impact on the passengers and air operations. By having a different delivery method other than design/did/build, the contractor and other entities may have some valuable insight as to how their means and methods will impact from the original phasing plans. The phasing can be altered prior to construction to better benefit the airport. However, the airport is always entitled to stand with their original plan and not deviate from it. In terms of a safety plan, it will always be the responsibility of the contractor to make sure that all activities are not only safe for their workers but is also safe for passengers and workers at the airport. I do not believe that an alternate delivery method would have a significant impact on the safety plan."

"While the engineer would need to produce the document regardless, having a contractor on board during the CSPP development would be integral in defining the CSPP, phasing and schedule. As it is, we have great engineers and construction staff familiar with airport construction

and constraints that occur on an airfield, but the actual contractor performing the work would aid in further refinement."

4.2.7 External factors impacting CSPP development

When asked whether external factors (e.g. major events, political events, weather) would have an impact on CSPP development, many respondents claimed weather to be a major consideration in phasing out the project. Some respondents claimed that these external factors would not have a significant impact in writing the plan. Some interesting responses on external factors included schedules being affected by airport curfew hours, tenants' access and movement, and major community events that impact air travel. One response noted that external events are planned on a case-by-case basis. A sample response noted:

"We take into consideration major community events that impact air travel in developing the CSPP to ensure we are minimizing negative impacts to these events as much as possible. Weather is a factor only in as much as it can impact visibility and our decision to permit closures during periods of low visibility."

4.2.8 Inefficient Practices

Fig 4.4 illustrates the different responses regarding inefficient practices and their frequency in terms of percentage. The most common inefficient practice for CSPP development reported by the survey was the lack of collaboration among the key stakeholders (30%). Having the CSPP author being unfamiliar with the airport was another common response. Other responses included late initiation of CSPP development, use of generalized templates, too early involvement of stakeholders (5%), errors in contracts, and safety management system (5%). The responses on too early stakeholder involvement claimed that stakeholders may not be fully aware of safety, security,

and constructability of the project. They may make a business decision rather than one more concerned with safety of the project.

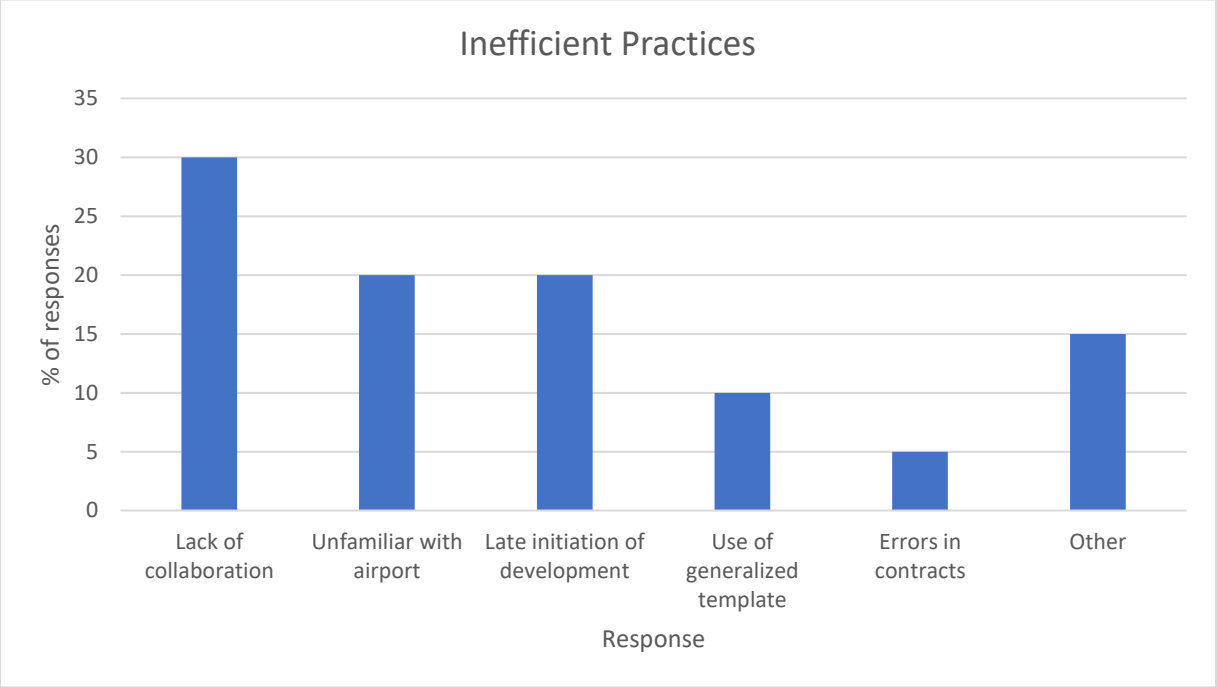

Figure 4.4: Inefficient CSPP practices from survey

Other responses on inefficient practices included allowing the contractor to deviate from the plan for cost savings, lack of contractor familiarity with airfield operations, different levels of feedback, and reviews from FAA Airports District Office. Some responses claimed they were unable to identify any inefficient practice in their process.

4.2.9 Good Practices

Fig 4.5 illustrates the good practices and their percentage of responses:

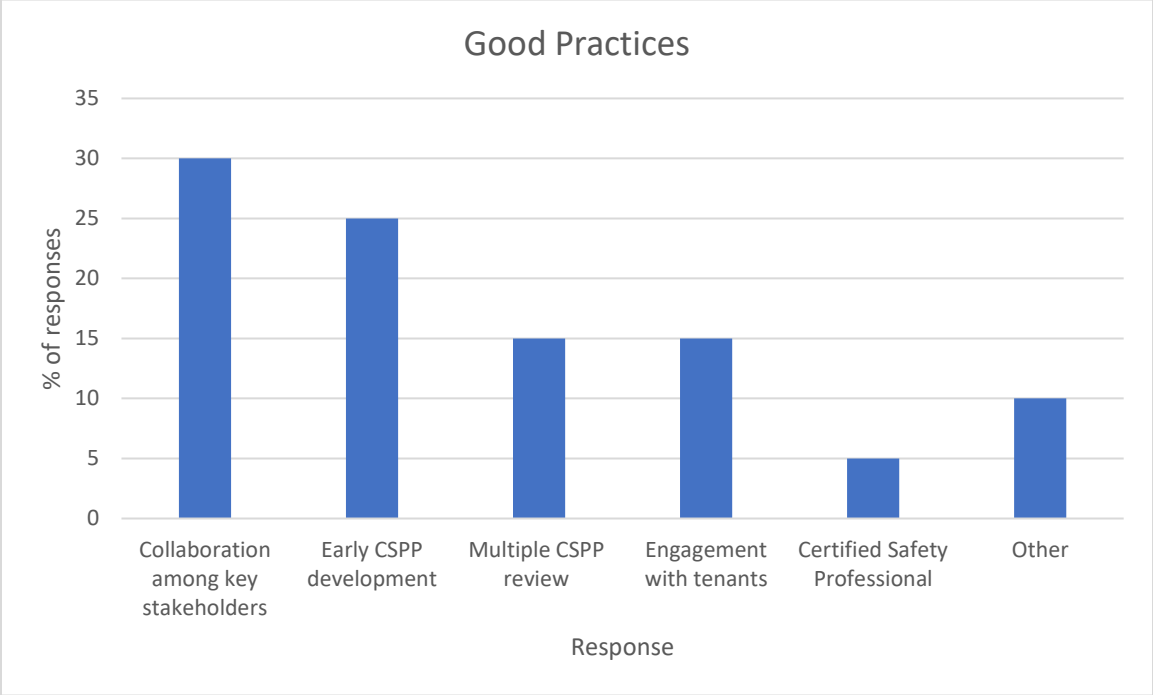

Figure 4.5: Good CSPP practices from survey

1. Frequent collaboration: The collaboration between all stakeholders involved with the project was the most frequent response (30%). The suggestions included having a stakeholder meeting with the airport to identify any special conditions and, working closely with the ATC to establish best taxi routes. Developing communication strategies and procedures for keeping all parties advised of the work process and potential conflicts is important as illustrated in the following sample response:

"Develop communication strategies and procedures for keeping all parties advised of the work process and potential conflicts. Utilizing text messaging and email via smart phones helped keep communications flowing. It also reduced the need for time consuming, face-to-face work progress meetings."

2. Early CSPP development: One type of responses noted developing and receiving feedback on the CSPP early into the process. It was claimed that this practice improves the modification process of the CSPP and helps have a clear project communication plan. Likewise, including early engagement and developments helps to identify conflicts and possible resolution prior to bidding. This point is emphasized through the following response:

"Including all stakeholders early, so conflicts can be identified and resolved prior to bidding (in Design, Bid, Build projects). We have had significant project change orders generated due to CSPP errors."

3. Multiple CSPP review: In another set of responses, it was claimed that reviewing the CSPP with multiple airport departments and external stakeholders eases the process. The following sample response highlights this point:

"Having multiple department leaders helps cover all aspects of the project. Engineering staff may not be as educated on Part 139 compliance and Operations staff are not aware of contractual issues related to construction."

4. Engagement with tenants: Some responses strongly encouraged frequent discussions with the tenants (15%). Some responses claimed that trying to get the tenants to change a habit for the sake of avoiding incursions and other safety issues requires a lot of communication. This is illustrated through the following sample response:

"There can never be too much communication with tenants. Strongly encourage frequent discussions with tenants. A contractor can usually be confined and controlled within a specific area, tenants on the other hand have likely been doing the same routine for years. Trying to get them to change a habit for the sake of avoiding incursions takes a lot of communication."

5. Having a Certified Safety Professional present at all times: Some responses emphasized the importance of a certified safety professional as shown in the following response:

"Certified safety personnel should review and approve the CSPP and monitor the project for safety violations. We also highly recommend having the contractor provided dedicated safety personnel full time on-site to ensure the CSPP is being followed and submit reports for any actions, corrections or incidents."

Other sample responses included:

"Submission of CSPP at 90% completion of design into iOE/AAA for review coordination. Typically, this allows sufficient time for the CSPP to be circulated for review comments prior to bidding so that modifications can be incorporated into the bid package."

"Have a stakeholder meeting with the airport to identify any special conditions related to the project that may impact the CSPP, such as working at night instead of during the day, etc."

The survey phase of the research concluded with data analysis. The survey results provided the information and knowledge to the researcher to perform more in-depth analysis of the topic using other means. The following are some key takeaways from the survey:

1) The CSPPs are developed in most airports by an external consultant
2) The airport construction industry lacks collaboration among its key stakeholders
3) Good practices to improve the creation, implementation, and management of CSPPs, as well as inefficient practices, were identified

4.4 Interview Findings

A total of 60 emails were sent out from June to September 2019 inviting the stakeholders to participate in a follow-up interview. Ten stakeholders responded back and a total of seven

interviews were conducted for this research. Table 4.2 shows information regarding the airport/company and their locations:

Table 4.2: Airport/Company category and its location

#	**Airport/Company**	**Location**
1	Small Hub Airport (2 participants)	Grand Rapids, MI
2	Non-Hub Primary Commercial	Freeland, MI
3	Consultant (2 participants)	Lansing, MI
4	Consultant	Traverse City, MI
5	Non-Hub Primary Commercial	Traverse City, MI

4.4.1 Small Hub Airport

Two interviews were conducted at a small hub airport in Michigan, one with the planning director and one with the engineering manager. Both participants had more than five years of experience dealing with CSPPs. After inquiring about the participant information, they were asked about strategies for improvement of the CSPP at their airport. Their airport conducts monthly stakeholder meetings for the ongoing construction project and trained relevant staff as the job progresses. The key stakeholders at the airport were identified as FAA technical operations, airport engineering, operations, and maintenance. When asked about the impact of the Safety Management System (SMS) at the airport, it was clarified that SMS is not mandated at their airport by the FAA since it is a small hub airport.

The good practices implemented during the creation stage of the CSPP included engaging stakeholders even before the CSPP development process began and effectively communicating notice to airmen (NOATM) prior to construction operations. The airport engaged various departments that included engineering, maintenance, operations, police, and property divisions. The advisory circular was used a baseline for CSPP creation at the airport. The importance of

communicating with the IT department of airlines was emphasized, as it takes significant time to move the IT department to an alternate gate/terminal.

4.4.2 Consulting Firm A

The personnel at this firm had more than 10 years of experience working on CSPP's. The key stakeholders defined by the interviewee were airport management, maintenance, and operations and depending on the size of the airport and size of the project, they also often include airlines, public safety officials (including aircraft rescue and firefighting), major airport tenants (such as cargo operators), air traffic control and the FAA.

In response to good practices implemented, the firm believed in following the FAA requirements and not attempting to improve them. Regarding SMS, it was said to be unfamiliar at most airports and the airports struggle to adequately produce a useful program. CSPPs are implemented by a contractor who is not a part of the SMS. Internal training was emphasized for the new staff. All new engineers work under the supervision of experienced project managers and licensed professional engineers who train them in all aspects of airfield design and construction planning, including CSPP development.

The most inefficient practice is the different definition of critical items among airport users, airport management and the FAA. Another inefficient implementation is when the CSPP plan, developed by the consultant, is executed by a contractor unfamiliar with airport operations and constraints.

4.4.3 Consulting Firm B

The airport planner at this firm was interviewed. The personnel had more than 10 years of experience in their position. The key stakeholders were identified as the airport, consultants, and contractors. External training of staff was emphasized as a good practice. The engineering staff attend industry webinars from the FAA to keep pace with recent developments in the industry.

Effective communication was also described as a good practice as it takes a lot of effort to collaborate between all key stakeholders. The use of SMS was considered as a good approach as it involved all key stakeholders meeting with an emphasis on safety.

An inefficient practice was described as the use of the same general advisory circular for large hub as well as small community airports. Contractors lacking experience with airfield operations was also described as inefficient and problematic at times.

4.4.4 Consulting Firm C

The interviewee has been working for the firm since 2012 and had more than 15 years of experience as an airport consultant responsible for the drafting and execution of CSPPs. Contractors, airport operations, airport management, project managers, project engineers, and the airlines are identified as the stakeholders involved in the process.

Construction fencing outside of the secured perimeter was identified as a good practice, as was the importance of planning ahead and submitting the CSPP on time for review, as the FAA might take up to three months for standard CSPP reviews and six to nine months for more complex CSPP reviews.

4.4.5 Non-Hub Primary Commercial Airport A

The airport manager at this airport was interviewed. The interviewee had more than 15 years of experience in their current position. All CSPPs at this airport were developed by a consultant. Consultants, airport staff, maintenance personnel, airport operations, and the airport rescue and firefighting chief were identified as the key stakeholders involved in the process.

A recommended good practice included having all key stakeholders involved in the CSPP review process and having a strong consultant who is familiar with the airport. One of the challenges faced by the airport was multiple stakeholders being aware of the intended construction in advance, but

the information not flowing through to the impacted stakeholders until late into the start of construction.

4.4.7 Non-Hub Primary Commercial Airport B

The Assistant Director of Operations and Maintenance has more than 24 years of experience in airport operations. The key stakeholders were defined as airlines, engineering and planning group, FAA ATC and operations, and the contractor. Their role was to review the CSPP with the engineers and ensure its validity. Some of the good practices recommended included holding frequent meeting to ensure all agendas were covered, referring to old plans that have worked well, and the use of construction fencing and barricades. Some challenges at the airport during construction were defined as coordinating with airlines when runways were shut down, schedule conflicts with the contractors and effective communication between all groups involved with the project.

4.5 Research Validation

An observational site visit in Michigan was conducted at an airport construction site in a small hub airport to validate the research findings and observe the implementation of a CSPP. The scope of project included a terminal apron reconstruction and rehabilitation of a taxiway. The project was executed using a Design-Bid-Build delivery method and was divided into seven different phases to accommodate operations of aircrafts without disruption. The phases were further divided into subphases. Construction phasing criteria included:

- Assignment of responsibilities to contractor and owner at various phases
- Scheduling of closures of gates and taxiway to minimize disruption of aircrafts
- Establishment of temporary roadways and temporary ramps for vehicles
- Durations for which a gate or taxiway could be closed

Good practices were observed at the construction site in accordance with the FAA advisory circular 150/5370-2G, such as use of continuous interlocking low-profile barricades, effective communication for notice to airmen, and appropriate marking of trenches by the contractor. Some of the good practices were captured in the following pictures:

Figure 4.6: Use of continuous low-profile barricades at the airport

Figure 4.7: Designated space close to the taxiway for contractor vehicles

Figure 4.8: Identification of proper egress and ingress routes for construction vehicle

A second visit to attend a kickoff meeting for an upcoming major project at the same airport was conducted. The scope of work involved the construction of eight new gates and amenities added to a concourse. The contractor presented a phasing schedule for the project and its feasibility was discussed. The closure of gates and impacts to airlines were the highest considerations during the phasing decisions. The stakeholders involved were the airport planning team, project managers from the contractors and the consultant, and the project architects.

This validation site visit highlighted the benefits of involving contractors in the CSPP development process as a key stakeholder.

4.6 Summary

This chapter presented findings from the research. Qualitative analysis was used to analyze the collected data. The survey findings were pooled together and presented in an aggregate form. Interview data was collected as written notes and the results from each interview were presented in the form of a summary. Finally, the key findings were presented from the case study as a summary and photographs of good practices at the construction site.

Chapter 5: Conclusions and Recommendations

5.1 Introduction

This chapter presents good practices from the research findings. Additionally, this chapter concludes the research with its limitations, and provides recommendations for future research.

5.2 Good Practices

The research summarizes the good practices that could be utilized by airports to improve the development, management, and execution of the CSPP process. Following are the key stakeholders and good practices identified by this research:

5.2.1 Identification of Stakeholders

The key stakeholders identified by survey and interview include both internal and external stakeholders and they are as follows:

- External Stakeholders: The key external stakeholders were identified as Contractors, FAA Technical Operations staff, Department of Transportation, Airport Users, and the Airlines.
- Internal Stakeholders: The key internal stakeholders were identified as the Airport Operators, Airport Management, Tenants, Airport Engineers, Airport Rescue and Firefighting, and Project Managers.

5.2.2 Collaboration Between Key Stakeholders

It was apparent that timely collaboration is the most important good practice for developing CSPP for airport projects. The focus needs to extend the traditional collaboration aspect to involve timely meetings and the correct audience for the review sessions to make the correct decision. This practice deals primarily with the collaboration and communication strategies and can be illustrated through the following points mentioned in the findings:

- Working closely with Air Traffic Control to establish the best taxi routes for aircrafts
- Developing strategies and procedures for keeping all parties advised of the work process and potential conflicts
- Engaging stakeholders before CSPP development begins
- Effectively communicating Notice to Airmen (NOATM) prior to construction operations
- Communication with the IT department of airlines as it takes a lot of time to move IT to an alternate gate/terminal
- Engagement with airport tenants
- Holding frequent meeting to ensure all agendas are covered

5.2.3 Developing CSPP early

The findings showed that early CSPP development improves the modification process of the CSPP and helps to have a clear project communication plan. Including early engagement and developments helps in identifying conflicts and resolving them prior to project bidding.

5.2.4 Identification of special conditions

A special condition could be an issue such as a major event, political event, major community event, or a weather related/natural incident. Factoring such events into CSPP development could have a significant impact on the project durations. Therefore, it is important to identify such events beforehand to mitigate future cost/schedule/safety effects on the project.

5.2.5 Using alternate delivery methods

More collaborative methods could be adopted by airports where the contractors, consultants, and airport personnel could work together to come up with a plan that works best for every party involved with the project. The CSPP plan is developed by a consultant and is executed by a contractor. The contractor may be unfamiliar with airport operations and constraints. A

contractor's input on project phasing is valuable to the projects. Having a contractor on board during CSPP development would be integral in defining the CSPP.

5.2.6 Training of employees

There are numerous advisory circulars at airports that guide the requirements for construction operations. However, there are no systematic standardized training protocols related to construction at airports. It is up to the airports to decide on the level and type of training provided to new employees, contractors, and other relevant personnel. Having a standardized systematic training could help new personnel get accustomed to both general and airport specific factors. This practice could be especially beneficial for the contractor's crew, who may not be accustomed to airport construction.

5.2.7 Hiring a consultant familiar with the airport

The experience and familiarity with the airport were found to be the most common rationale for selecting the CSPP developer. Selecting a consultant familiar with the airport is a good practice, as those consultants have expertise with the FAA, practical requirements, experience, and a detailed understanding of several airfield projects.

5.3 Other Potential Practices

In addition to the recommended practices provided, there are other potential practices that have the prospect of improving CSPP at airports.

5.3.1 Including a certified safety professional

Construction safety supervisors are essential to the site safety execution. Most CSPP inspections calls for a full-time safety inspector for the monitoring of activities through construction. This inspector could be from the owner's representative or the contractor, depending on the contract.

According to the FAA Advisory Circular 150/5370-2G, in addition to the contractor's required inspections, airport operations may inspect the construction site up to three times a day to ensure compliance with the CSPP and the SPCD. Including a Certified Safety Professional is considered a good practice as it can help avoid or remedy any hazardous or potentially unsafe situations as soon as they are discovered. It helps ensure the CSPP is being followed and that any actions, corrections, or incidents related to safety are documented.

5.3.2 Using continuous interlocking low-profile barricades

Barricades are typically installed along the runway holding position when construction is conducted adjacent to an active runway. Low profile barricades, (weighted or sturdily attached to the surface) are acceptable methods used to identify and define the limits of construction and hazardous areas on airports (FAA, 2017). The barricades must be spaced so that a breach should be physically prevented, excluding a deliberate act. The barricades must be continuously linked if they intend to keep out pedestrians. Securely attached ropes could be used to continuously link the barricades. If the barricades are in the runway safety area, they must of low mass and easily collapsible. The use of continuous interlocking barricades was considered as a good practice in research validation for construction projects at airports.

5.3.3 Using construction fencing outside of the secured perimeter

The FAA AC 150/5370-2G recommends procedures to make sure only authorized personnel and vehicles can access the air operations area. The movement of construction personnel and vehicles should be restricted using barricades, flagging, erection of temporary fences, or providing escorts, as applicable according to the CSPP and SPCD. Fences help the airport in wildlife management, airport security, movement restriction of construction personnel and vehicles in the air operations area. The use of construction fencing outside the secured perimeter was considered among the good

practices at a Michigan airport. There must be sufficient distance provided between the aircraft parking area and the perimeter fencing. Clear area provisions must be provided on both sides of the fence to improve security effectiveness.

5.3.4 Using a detailed CSPP document

The findings show that many participants viewed the use of a generalized CSPP template as an inefficient practice and suggested using a more detail version. The most recent version of the FAA Advisory Circular for Operational Safety of Airports During Construction is used as a baseline for creating the CSPP document. However, the level of detail is decided by the development stakeholders. Airports could provide more detailed guidelines on the CSPP elements to enhance the level of safety and security of the project. Contractors should also provide a more detailed Safety Plan and Compliance Document to comply with the CSPP requirements.

5.4 Research Contribution

This research contributes to CSPP creation, development, and implementation in the following ways:

1. The results of the study identify the key stakeholders involved in the CSPP process. This could help in collaboration between these stakeholders to improve the overall CSPP process.

2. The study identifies the current practices utilized by airports for the CSPP development process. This helps to understand the various components of a CSPP and the similarities between the documents across the country.

3. The study presents good practices for CSPP creation, development, and implementation at airports. This could help airport stakeholders to supplement their existing practices and thereby, improve the overall CSPP process at their airports.

5.4 Research Limitations

The following could be defined as the limitations of this study:

- The good practices addressed in this research are obtained from a limited number of stakeholders across the United States.
- The stakeholders selected for interview for this research were limited to Michigan. This may skew the applicability of collected data towards a specific state.
- The modifications and developments such as change in the advisory circulars and other regulatory changes can influence the applicability of the practices contained in this thesis.

5.5 Recommendation for future research

This research conducted an exploratory study for CSPP and its good practices. Using the results presented here, additional efforts can be taken to validate the results using large data samples. These efforts could comprise alternate data collection strategies to supplement the current research methods. Multiple case studies could be conducted across various airports to observe the development of projects with the respect to their individual CSPP document. This will result in more detailed guidelines on how airports can adopt these practices.

Additionally, safety management system and safety risk management are two areas that could be further studied in relation to airport construction and CSPP guidelines.

5.6 Conclusion

The primary objective of this research was to present good practices during CSPP creation, implementation, and management. This was achieved using a combination of an online survey, semi- structured interviews, and one in depth case study. The collected data was analyzed using qualitative analysis. The findings from this research show that there are practices that could be

utilized by the airports to improve the overall CSPP process. The recommendations provided in this thesis can be used to supplement the existing practices with other sources as applicable.

APPENDICES

APPENDIX A Sample Daily Safety Inspection Checklist

Construction Project Daily Safety Inspection Checklist

The situations identified below are potentially hazardous conditions that may occur during airport construction projects. Safety Area encroachments, unauthorized and improper ground vehicle operations, and unmarked or uncovers holes and trenches near aircraft operating surfaces pose the most prevalent threats to airport operational safety during airport construction projects. The list below is one tool that the contractor may use to aid in identifying and correcting potentially hazardous conditions.

Potentially Hazardous Conditions

Item	Action Required	or	None
Excavation adjacent to runways, taxiways, and aprons improperly backfilled.			☐
Mounds of earth, construction materials, temporary structures, and other obstacles near any open runway, taxiway, or taxi lane; in the related Object Free area and aircraft approach or departure areas/zones; or obstructing any sign or marking.			☐
Heavy equipment (stationary or mobile) operating or idle near AOA.			☐
Equipment or material near NAVAIDs that may degrade or impair radiated signals and/or the monitoring of navigation and visual aids. Unauthorized or improper vehicle operations in localizer or glide slope critical areas, resulting in electronic interference and/or facility shutdown.			☐
Tall and especially relatively low visibility units (that is, equipment with slim profiles) –cranes, drills, and similar objects—located in critical areas, such as OFZ and approach zones.			☐
Improperly positioned or malfunctioning lights or unlighted airport hazards, such as holes or excavations, on an apron, open taxiway, or open taxi lane or in related safety, approach, or departure area.			☐
Obstacles, loose pavement, trash, and other debris on or near AOA. Construction debris (gravel, sand, mud, paving materials) on airport pavements may result in aircraft propeller, turbine engine, or tire damage. Also, loose materials may blow about, potentially causing personal injury or equipment damage.			☐

Item	Action Required	or	None
Inappropriate or poorly maintained fencing during construction intended to deter human and animal intrusions into the AOA. Fencing and other markings that are inadequate to separate construction areas from open AOA create aviation hazards.			☐
Inadequate or improper methods of marking, barricading, and lighting of temporarily closed portions of AOA create aviation hazards.			☐
Wildlife attractants — such as trash (food scraps not collected from construction personnel activity), grass seeds, tall grass, or standing water — on or near airports.			
Obliterated or faded temporary markings on active operational areas.			☐
Failure to issue, update, or cancel NOTAMs about airport or runway closures or other construction related airport conditions.			☐
Failure to mark and identify utilities or power cables. Damage to utilities and power cables during construction activity can result in the loss of runway / taxiway lighting; loss of navigation, visual, or approach aids; disruption of weather reporting services; and/or loss of communications.			☐
Restrictions on ARFF access from fire stations to the runway / taxiway system or airport buildings.			
Lack of radio communications with construction vehicles in airport movement areas.			☐
Objects, regardless of whether they are marked or flagged, or activities anywhere on or near an airport that could be distracting, confusing, or alarming to pilots during aircraft operations.			☐
Water, snow, dirt, debris, or other contaminants that temporarily obscure or derogate the visibility of runway/taxiway marking, lighting, and pavement edges. Any condition or factor that obscures or diminishes the visibility of areas under construction.			☐

Item	Action Required	or	None
Spillage from vehicles (gasoline, diesel fuel, oil) on active pavement areas, such as runways, taxiways, aprons, and airport roadways.			☐
Failure to maintain drainage system integrity during construction (for example, no temporary drainage provided when working on a drainage system).			
Failure to provide for proper electrical lockout and tagging procedures. At larger airports with multiple maintenance shifts/workers, construction contractors should make provisions for coordinating work on circuits.			☐
Failure to control dust. Consider limiting the amount of area from which the contractor is allowed to strip turf.			☐
Exposed wiring that creates an electrocution or fire ignition hazard. Identify and secure wiring, and place it in conduit or bury it.			☐
Site burning, which can cause possible obscuration.			☐
Construction work taking place outside of designated work areas and out of phase.			☐

APPENDIX B Survey IRB Document

MICHIGAN STATE
UNIVERSITY

EXEMPT DETERMINATION
Revised Common Rule

March 5, 2019

To: Mohamed Anwar El-Gafy

Re: **MSU Study ID:** STUDY00002287
Principal Investigator: Mohamed Anwar El-Gafy
Category: Exempt 2(i)
Exempt Determination Date: 3/5/2019
Limited IRB Review: Not Required.

Title: Construction Safety and Phasing Plans (CSPP): Current Practices

This study has been determined to be exempt under 45 CFR 46.104(d) 2(i).

Principal Investigator (PI) Responsibilities: The PI assumes the responsibilities for the protection of human subjects in this study as outlined in Human Research Protection Program (HRPP) Manual Section 8-1, Exemptions.

Continuing Review: Exempt studies do not need to be renewed.

Modifications: In general, investigators are not required to submit changes to the Michigan State University (MSU) Institutional Review Board (IRB) once a research study is designated as exempt as long as those changes do not affect the exempt category or criteria for exempt determination (changing from exempt status to expedited or full review, changing exempt category) or that may substantially change the focus of the research study such as a change in hypothesis or study design. See HRPP Manual Section 8-1, Exemptions, for examples. If the study is modified to add additional sites for the research, please note that you may not begin the research at those sites until you receive the appropriate approvals/permissions from the sites.

Please contact the HRPP office if you have any questions about whether a change must be submitted for IRB review and approval.

New Funding: If new external funding is obtained for an active study that had been determined exempt, a new initial IRB submission will be required, with limited exceptions. If you are unsure if a new initial IRB submission is required, contact the HRPP office. IRB review of the new submission must be completed before new funds can be spent on human research activities, as the new funding source may have additional or different requirements.

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problem that may increase the risk to the human subjects and change the category of review, notify the IRB office promptly. Any complaints from participants that may change the level of review from exempt to expedited or full review must be reported to the IRB. Please report new information through the study's workspace and contact the IRB office with any urgent events. Please visit the Human Research Protection Program (HRPP) website to obtain more information, including reporting timelines.

Personnel Changes: After determination of the exempt status, the PI is responsible for maintaining records of personnel changes and appropriate training. The PI is not required to notify the IRB of personnel changes on exempt research. However, he or she may wish to submit personnel changes to the IRB for recordkeeping purposes (e.g. communication with the Graduate School) and may submit such requests by submitting a Modification request. If there is a change in PI, the new PI must confirm acceptance of the PI Assurance form and the previous PI must submit the Supplemental Form to Change the Principal Investigator with the Modification request (available at hrpp.msu.edu).

Closure: Investigators are not required to notify the IRB when the research study can be closed. However, the PI can choose to notify the IRB when the study can be closed and is especially recommended when the PI leaves the university. Closure indicates that research activities with human subjects are no longer ongoing, have stopped, and are complete. Human research activities are complete when investigators are no longer obtaining information or biospecimens about a living person through interaction or intervention with the individual, obtaining identifiable private information or identifiable biospecimens about a living person, and/or using, studying, analyzing, or generating identifiable private information or identifiable biospecimens about a living person.

For More Information: See HRPP Manual, including Section 8-1, Exemptions (available at hrpp.msu.edu).

Contact Information: If we can be of further assistance or if you have questions, please contact us at 517-355-2180 or via email at IRB@msu.edu. Please visit hrpp.msu.edu to access the HRPP Manual, templates, etc.

Exemption Category. The full regulatory text from 45 CFR 46.104(d) for the exempt research categories is included below. [1234]

Exempt 1. Research, conducted in established or commonly accepted educational settings, that specifically involves normal educational practices that are not likely to adversely impact students' opportunity to learn required educational content or the assessment of educators who provide instruction. This includes most research on regular and special education instructional strategies, and research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

Exempt 2. Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview

procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:

(i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

(ii) Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or

(iii) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by 45 CFR 46.111(a)(7).

Exempt 3. (i) Research involving benign behavioral interventions in conjunction with the collection of information from an adult subject through verbal or written responses (including data entry) or audiovisual recording if the subject prospectively agrees to the intervention and information collection and at least one of the following criteria is met:

(A) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

(B) Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or

(C) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by 45 CFR 46.111(a)(7).

(ii) For the purpose of this provision, benign behavioral interventions are brief in duration, harmless, painless, not physically invasive, not likely to have a significant adverse lasting impact on the subjects, and the investigator has no reason to think the subjects will find the interventions offensive or embarrassing. Provided all such criteria are met, examples of such benign behavioral interventions would include having the subjects play an online game, having them solve puzzles under various noise conditions, or having them decide how to allocate a nominal amount of received cash between themselves and someone else.

(iii) If the research involves deceiving the subjects regarding the nature or purposes of the research, this exemption is not applicable unless the subject authorizes the deception through a prospective agreement to participate in research in circumstances in which the subject is informed that he or she will be unaware of or misled regarding the nature or purposes of the research.

Exempt 4. Secondary research for which consent is not required: Secondary research uses of identifiable private information or identifiable biospecimens, if at least one of the following criteria is met:

(i) The identifiable private information or identifiable biospecimens are publicly available;

(ii) Information, which may include information about biospecimens, is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained directly or through identifiers linked to the subjects, the investigator does not contact the subjects, and the investigator will not re-identify subjects;

(iii) The research involves only information collection and analysis involving the investigator's use of identifiable health information when that use is regulated under 45 CFR parts 160 and 164, subparts A and E, for the purposes of ``health care operations'' or ``research'' as those terms are defined at 45 CFR 164.501 or for ``public health activities and purposes'' as described under 45 CFR 164.512(b); or

(iv) The research is conducted by, or on behalf of, a Federal department or agency using government-generated or government-collected information obtained for nonresearch activities, if the research generates identifiable private information that is or will be maintained on information technology that is subject to and in compliance with section 208(b) of the E-Government Act of 2002, 44 U.S.C. 3501 note, if all of the identifiable private information collected, used, or generated as part of the activity will be maintained in systems of records subject to the Privacy Act of 1974, 5 U.S.C. 552a, and, if applicable, the information used in the research was collected subject to the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 et seq.

Exempt 5. Research and demonstration projects that are conducted or supported by a Federal department or agency, or otherwise subject to the approval of department or agency heads (or the approval of the heads of bureaus or other subordinate agencies that have been delegated authority to conduct the research and demonstration projects), and that are designed to study, evaluate, improve, or otherwise examine public benefit or service programs, including procedures for obtaining benefits or services under those programs, possible changes in or alternatives to those programs or procedures, or possible changes in methods or levels of payment for benefits or services under those programs. Such projects include, but are not limited to, internal studies by Federal employees, and studies under contracts or consulting arrangements, cooperative agreements, or grants. Exempt projects also include waivers of otherwise mandatory requirements using

authorities such as sections 1115 and 1115A of the Social Security Act, as amended. (i) Each Federal department or agency conducting or supporting the research and demonstration projects must establish, on a publicly accessible Federal Web site or in such other manner as the department or agency head may determine, a list of the research and demonstration projects that the Federal department or agency conducts or supports under this provision. The research or demonstration project must be published on this list prior to commencing the research involving human subjects.

Exempt 6. Taste and food quality evaluation and consumer acceptance studies: (i) If wholesome foods without additives are consumed, or (ii) If a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

Exempt 7. Storage or maintenance for secondary research for which broad consent is required: Storage or maintenance of identifiable private information or identifiable biospecimens for potential secondary research use if an IRB conducts a limited IRB review and makes the determinations required by 45 CFR 46.111(a)(8).

Exempt 8. Secondary research for which broad consent is required: Research involving the use of identifiable private information or identifiable biospecimens for secondary research use, if the following criteria are met:

> (i) Broad consent for the storage, maintenance, and secondary research use of the identifiable private information or identifiable biospecimens was obtained in accordance with 45 CFR 46.116(a)(1) through (4), (a)(6), and (d);
>
> (ii) Documentation of informed consent or waiver of documentation of consent was obtained in accordance with 45 CFR 46.117;
>
> (iii) An IRB conducts a limited IRB review and makes the determination required by 45 CFR 46.111(a)(7) and makes the determination that the research to be conducted is within the scope of the broad consent referenced in paragraph (d)(8)(i) of this section; and
>
> (iv) The investigator does not include returning individual research results to subjects as part of the study plan. This provision does not prevent an investigator from abiding by any legal requirements to return individual research results.

[1]Exempt categories (1), (2), (3), (4), (5), (7), and (8) cannot be applied to activities that are FDA-regulated.

[2] Each of the exemptions at this section may be applied to research subject to subpart B (Additional Protections for Pregnant Women, Human Fetuses and Neonates Involved in Research) if the conditions of the exemption are met.

APPENDIX C Interview IRB Document

MICHIGAN STATE
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EXEMPT DETERMINATION
Revised Common Rule

July 9, 2019

To: Mohamed Anwar El-Gafy

Re: **MSU Study ID:** STUDY00002974
Principal Investigator: Mohamed Anwar El-Gafy
Category: Exempt 2(ii)
Exempt Determination Date: 7/9/2019
Limited IRB Review: Not Required.

Title: Construction Safety and Phasing Plans (CSPP): Best Practices

This study has been determined to be exempt under 45 CFR 46.104(d) 2(ii).

Principal Investigator (PI) Responsibilities: The PI assumes the responsibilities for the protection of human subjects in this study as outlined in Human Research Protection Program (HRPP) Manual Section 8-1, Exemptions.

Continuing Review: Exempt studies do not need to be renewed.

Modifications: In general, investigators are not required to submit changes to the Michigan State University (MSU) Institutional Review Board (IRB) once a research study is designated as exempt as long as those changes do not affect the exempt category or criteria for exempt determination (changing from exempt status to expedited or full review, changing exempt category) or that may substantially change the focus of the research study such as a change in hypothesis or study design. See HRPP Manual Section 8-1, Exemptions, for examples. If the study is modified to add additional sites for the research, please note that you may not begin the research at those sites until you receive the appropriate approvals/permissions from the sites.

Please contact the HRPP office if you have any questions about whether a change must be submitted for IRB review and approval.

New Funding: If new external funding is obtained for an active study that had been determined exempt, a new initial IRB submission will be required, with limited exceptions. If you are unsure if a new initial IRB submission is required, contact the HRPP office. IRB review of the new submission must be completed before new funds can be spent on human research activities, as the new funding source may have additional or different requirements.

Reportable Events: If issues should arise during the conduct of the research, such as unanticipated problems that may involve risks to subjects or others, or any

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problem that may increase the risk to the human subjects and change the category of review, notify the IRB office promptly. Any complaints from participants that may change the level of review from exempt to expedited or full review must be reported to the IRB. Please report new information through the study's workspace and contact the IRB office with any urgent events. Please visit the Human Research Protection Program (HRPP) website to obtain more information, including reporting timelines.

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For More Information: See HRPP Manual, including Section 8-1, Exemptions (available at hrpp.msu.edu).

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Exemption Category. The full regulatory text from 45 CFR 46.104(d) for the exempt research categories is included below. [1234]

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Exempt 2. Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview

procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:

(i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

(ii) Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or

(iii) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by 45 CFR 46.111(a)(7).

Exempt 3. (i) Research involving benign behavioral interventions in conjunction with the collection of information from an adult subject through verbal or written responses (including data entry) or audiovisual recording if the subject prospectively agrees to the intervention and information collection and at least one of the following criteria is met:

(A) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

(B) Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or

(C) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by 45 CFR 46.111(a)(7).

(ii) For the purpose of this provision, benign behavioral interventions are brief in duration, harmless, painless, not physically invasive, not likely to have a significant adverse lasting impact on the subjects, and the investigator has no reason to think the subjects will find the interventions offensive or embarrassing. Provided all such criteria are met, examples of such benign behavioral interventions would include having the subjects play an online game, having them solve puzzles under various noise conditions, or having them decide how to allocate a nominal amount of received cash between themselves and someone else.

(iii) If the research involves deceiving the subjects regarding the nature or purposes of the research, this exemption is not applicable unless the subject authorizes the deception through a prospective agreement to participate in research in circumstances in which the subject is informed that he or she will be unaware of or misled regarding the nature or purposes of the research.

Exempt 4. Secondary research for which consent is not required: Secondary research uses of identifiable private information or identifiable biospecimens, if at least one of the following criteria is met:

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(ii) Information, which may include information about biospecimens, is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained directly or through identifiers linked to the subjects, the investigator does not contact the subjects, and the investigator will not re-identify subjects;

(iii) The research involves only information collection and analysis involving the investigator's use of identifiable health information when that use is regulated under 45 CFR parts 160 and 164, subparts A and E, for the purposes of ``health care operations'' or ``research'' as those terms are defined at 45 CFR 164.501 or for ``public health activities and purposes'' as described under 45 CFR 164.512(b); or

(iv) The research is conducted by, or on behalf of, a Federal department or agency using government-generated or government-collected information obtained for nonresearch activities, if the research generates identifiable private information that is or will be maintained on information technology that is subject to and in compliance with section 208(b) of the E-Government Act of 2002, 44 U.S.C. 3501 note, if all of the identifiable private information collected, used, or generated as part of the activity will be maintained in systems of records subject to the Privacy Act of 1974, 5 U.S.C. 552a, and, if applicable, the information used in the research was collected subject to the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 et seq.

Exempt 5. Research and demonstration projects that are conducted or supported by a Federal department or agency, or otherwise subject to the approval of department or agency heads (or the approval of the heads of bureaus or other subordinate agencies that have been delegated authority to conduct the research and demonstration projects), and that are designed to study, evaluate, improve, or otherwise examine public benefit or service programs, including procedures for obtaining benefits or services under those programs, possible changes in or alternatives to those programs or procedures, or possible changes in methods or levels of payment for benefits or services under those programs. Such projects include, but are not limited to, internal studies by Federal employees, and studies under contracts or consulting arrangements, cooperative agreements, or grants. Exempt projects also include waivers of otherwise mandatory requirements using

authorities such as sections 1115 and 1115A of the Social Security Act, as amended. (i) Each Federal department or agency conducting or supporting the research and demonstration projects must establish, on a publicly accessible Federal Web site or in such other manner as the department or agency head may determine, a list of the research and demonstration projects that the Federal department or agency conducts or supports under this provision. The research or demonstration project must be published on this list prior to commencing the research involving human subjects.

Exempt 6. Taste and food quality evaluation and consumer acceptance studies: (i) If wholesome foods without additives are consumed, or (ii) If a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

Exempt 7. Storage or maintenance for secondary research for which broad consent is required: Storage or maintenance of identifiable private information or identifiable biospecimens for potential secondary research use if an IRB conducts a limited IRB review and makes the determinations required by 45 CFR 46.111(a)(8).

Exempt 8. Secondary research for which broad consent is required: Research involving the use of identifiable private information or identifiable biospecimens for secondary research use, if the following criteria are met:

> (i) Broad consent for the storage, maintenance, and secondary research use of the identifiable private information or identifiable biospecimens was obtained in accordance with 45 CFR 46.116(a)(1) through (4), (a)(6), and (d);
>
> (ii) Documentation of informed consent or waiver of documentation of consent was obtained in accordance with 45 CFR 46.117;
>
> (iii) An IRB conducts a limited IRB review and makes the determination required by 45 CFR 46.111(a)(7) and makes the determination that the research to be conducted is within the scope of the broad consent referenced in paragraph (d)(8)(i) of this section; and
>
> (iv) The investigator does not include returning individual research results to subjects as part of the study plan. This provision does not prevent an investigator from abiding by any legal requirements to return individual research results.

[1]Exempt categories (1), (2), (3), (4), (5), (7), and (8) cannot be applied to activities that are FDA-regulated.

[2] Each of the exemptions at this section may be applied to research subject to subpart B (Additional Protections for Pregnant Women, Human Fetuses and Neonates Involved in Research) if the conditions of the exemption are met.

APPENDIX D Survey consent form and questionnaire

Qualtrics Survey Software

Construction Safety and Phasing Plans: Current Practices

You are being asked to participate in a research study. The objective of this research is to identify the current practices utilized by airports in creating, implementing, and managing a Construction Safety and Phasing Plans (CSPP). We have created the following questionnaire for data collection and would appreciate your participation in this survey questionnaire or help us by forwarding it to other experts who have relevant experience in creating and implementing CSPP. It is expected that the survey will take 6-10 minutes to complete.

Your participation is very helpful and will assist us in achieving the research objectives. We expect very minimal foreseeable risks in your participation. We expect five hundred responses. Survey responses would be kept confidential, as responses would be reported only in aggregate form.

If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact the researcher (Dr. Mohamed El-Gafy, Associate Professor, 314 Human Ecology, East Lansing, MI 48823, **elgafy@msu.edu**, 517-512-3132).

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study,

you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Rd, Suite 136, Lansing, MI 48910.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to stop.

By clicking on the following arrow, you consent that you voluntarily agree to participate.

Construction Safety and Phasing Plans: Current Practices

How could you identify your profession?

Airport Operator	Contractor
Airport Engineer	FAA Inspector
Airport Consultant	Other, Please specify

FAA Region/ State

Alaskan	Northwest Mountain (CO, ID, MT, OR, UT, WA, WY)
Central (IA, KS, MO, NE)	Southern (AL, FL, GA, KY, MS, NC, PR, SC, TN, VI)
Eastern (DC, DE, MD, NJ, NY, PA, VA, WV)	Southwest (AR, LA, NM, OK, TX)
Great Lakes (IL, IN, MI, MN, ND, OH, SD, WI)	Western-Pacific (AZ, CA, HI, NV, GU, AS, MH)

New England (CT, ME, MA, NH, RI, VT)

Please state the IATA airport code/ name of the airport that you currently working for/serving.

How many projects did you have created/ implemented a CSPP in the last year?

Construction Safety and Phasing Plans: Current Practices

In creating your last CSPP, please define the internal stakeholders and their involvement?

In creating your last CSPP, please define the external stakeholders and their involvement?

In creating your last CSPP, Would you consider other issues (i.e. major events, political events, weather, etc.) to be a factor in writing the plan?

Would the CSPP development process change by changing the project delivery system (Time& material, design Build, Integrated project delivery, Partnership)? please illustrate.

Construction Safety and Phasing Plans: Current Practices

For the last three projects with CSPP, who did create the plan?

For the last three projects, what was the rationale for selecting this person/ company to create the CSPP?

For the last three projects, and considering the CSPP quality and stakeholder collaboration for the project, Would it be improved is it was written by a different person/firm? please comment on your answer.

Could you identify one inefficient practice that should be avoided based on lessons learned from previous CSPP Development?

Could you identify one efficient practice (best practice) that should be idendified based on lessons learned from previous CSPP Development?

Do you currently have a checklist/standard process to assist in creating, implementing, and managing a CSPP?

No

Yes (If yes, please specify)

Do you provide any training for CSPP development?

No

Yes (if yes, please specify)

Do you provide any training for CSPP Implementation?

No

Yes (If yes, please specify)

If Possible, Could you share a sample of a recent CSPP? please upload

If Possible, Could you share a sample of a recently documented CSPP lessons learned during implemntation ? please upload

Would you be interested in a follow-up face-2-face or skype interview later?

No

Yes (If yes, Please provide your email address)

please let us know any other thoughts that we should consider during conducting our research on the current practices for developing safety plans for airports.

APPENDIX E Interview Protocol and Consent Form

Interview Protocol

Institution Name:

Interviewee (Title and Name):

Interviewer:

Introduction:

We are trying to learn more about the CSPP implementation at airports, the best practices and the challenges faced to help us with our research.

For today's interview, the objectives are to:

1. Discuss and collect data on current practices on CSPP development.

2. Discuss and collect data on the collaboration among the internal and external stakeholders.

3. Discuss and collect data on the potential best practices which could be utilized by the airports.

Questions:

A. Interviewee Background

How long have you been working in your present position?
How long have you been working at this airport?

Briefly describe your role as it relates to Construction Safety and Phasing Plans.

B. Does your airport/company have any strategy for improvement of CSPP's? If yes, what is it?

C. Who are the stakeholders involved in the CSPP development at your airport/company? What is their relative involvement at different stages?

D. Does your airport/company provide any training for the development and implementation of the CSPP?

E. What are the best practices adopted at your airport for the implementation of the CSPP's?

F. What do you think of the impact a Safety Management System (SMS) has on the implementation of CSPP?

G. What are some of the inefficient practices you have encountered during CSPP creation and implementation?

H. What are the challenges faced by the airport to ensure collaboration among all parties involved? What would be your suggestion on dealing with these challenges?

I. What are the technological advancements in terms of construction employed by your airport to improve the delivery of the project in a safe manner?

J. Does your airport have an internal communication checklist for airport personnel during construction? If yes, what are the safety provisions in it?

K. Do you formally capture and publish lessons learned and best practices?

General Suggestions and Comments:

Additional Comments:

End of Interview:
Thank you for your time and participation.

Consent Form

Consent to Participate in Research:

You are being asked to participate in a research study. The objective of this research is to identify the current practices currently utilized by airports in creating, implementing, and managing a Construction Safety and Phasing Plans (CSPP). We have created the following interview protocol for data collection and would appreciate your participation in this interview.

Your participation is very helpful and will assist us in achieving the research objectives. We expect very minimal foreseeable risks in your participation. You have the right to stop your participation at any time as you please. Interview responses would be kept confidential, as responses would be reported only in aggregate form.

If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact the researcher (Dr. Mohamed El-Gafy, Associate Professor, 314 Human Ecology, East Lansing, MI 48823, **elgafy@msu.edu**, 517-512-3132).

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Rd, Suite 136, Lansing, MI 48910.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to stop.

By entering your initial below, you consent that you voluntarily agree to participate.

Signature:

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REFERENCES

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