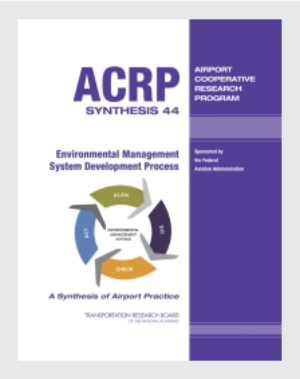

Environmental Management System Development Process

DETAILS

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP SYNTHESIS 44

Environmental Management System Development Process

A Synthesis of Airport Practice

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

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Cover Figure: Plan-Do-Check-Act Model. *Credit:* First Environment, Inc.

FOREWORD

Airport administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to the airport industry. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire airport community, the Airport Cooperative Research Program authorized the Transportation Research Board to undertake a continuing project. This project, ACRP Project 11-03, "Synthesis of Information Related to Airport Practices," searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute an ACRP report series, *Synthesis of Airport Practice*.

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

PREFACE

By Gail R. Staba
Senior Program Officer
Transportation Research Board

This synthesis reports on the current practice of environmental management system (EMS) development at airports in the United States and Canada—why this is occurring, what they look like, and how they were developed. The report provides guidance to airports with regard to the current state of practice in the airport industry and answers questions that airport managers and personnel responsible for environmental management at airports may have on what their peers are doing. It is written for an audience that may not have extensive familiarity with the technical details of EMS. The study provides background on the framework of an EMS, similarities and differences of the various approaches, the development process, and lessons learned by airports that have EMS experience.

Information was collected through a literature review and telephone interviews, with a follow-up electronic survey of 20 airports having experience with EMS. All 20 airports responded to the telephone interview and 19 of 20 responded to the electronic survey.

Elizabeth Delaney, First Environment, Inc., Boonton, New Jersey, and Barbara Thomson, First Environment, Inc., Philadelphia, Pennsylvania, collected and synthesized the information and wrote the report. The members of the topic panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

CONTENTS

Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

ENVIRONMENTAL MANAGEMENT SYSTEM DEVELOPMENT PROCESS

SUMMARY

Environmental Management Systems (EMS) are increasingly being used in the airport industry to manage environmental and sustainability issues. Typically, EMS are designed to ensure that an airport appropriately manages operations that have a potential for significant impact on the environment or are associated with regulatory requirements.

This synthesis reports on the current practice of EMS development at airports in the United States and Canada—why this is occurring, what practices look like, and how they were developed. The report provides guidance to airports with regard to the current state of the practice in the airport industry and answers questions that airport managers and personnel responsible for environmental management may have on what their peers are doing. It is written for an audience that may not have extensive familiarity with the technical details of EMS.

The study provides background on the framework of an EMS, similarities and differences of various approaches, the development process, and lessons learned by 19 airports that have EMS experience. The airports surveyed include 12 that had an established EMS in place; four that were considering an EMS; one in the process of evaluating an EMS; and two that evaluated and decided not to implement an EMS.

Three primary methods were used to gather the information synthesized in this report: a literature search, a telephone interview, and a follow-up electronic survey of 20 airports having experience with EMS. All 20 airports participated in the telephone interview and 19 responded to the electronic survey. Results were aggregated, but airports identified as having unique approaches were used to illustrate differences in approach on specific EMS issues. Two of these airports were then asked to participate in case studies, the results of which can be found located in text boxes next to the survey results to which they relate.

The synthesis study found that, according to the airports with established programs, EMS are an effective way to reduce environmental impacts, improve environmental performance, and increase operating efficiency for any size airport. All the airports with EMS in place reported that they had achieved the desired benefits that had initially motivated them to implement an EMS, especially improved environmental performance and greater employee understanding of environmental issues and responsibilities. This finding supports the underlying basis for management systems; that is, that defined and aligned structures, resources, and processes will lead to improved performance. The survey also indicated that one of the reasons early implementers had developed an EMS was to demonstrate their leadership within the airport industry, and that the development of their EMS had supported this ambition.

In general, the airports reported that they are following the ISO 14001 environmental management systems standard, an international standard that is considered a benchmark, and can be third-party certified. While only half of the airports with established EMS are ISO 14001-certified, most airports in the survey report using most or the entire framework of ISO 14001. The survey also indicated that an EMS can start small and still achieve benefits. The differences in the scope of operations included in the airport EMS ranged from a program that addressed a single operation to a plan that included all airport operations, including

those of tenants and other operators at the airport. One was even part of a city-wide effort that involved developing an EMS for all municipal operations. Several airports that initially developed an EMS for just a portion of their operation are planning to expand their programs to include additional operations.

Just as there is broad flexibility in the scope of an EMS, an EMS allows flexibility with regard to the issues managed within the system. Most airports reported managing all their compliance issues, such as stormwater and air emissions, within their EMS; and many also addressed sustainability issues such as alternative-fueled fleets and green buildings. This indicates that an EMS can provide a framework to support and advance an airport's environmental performance ambitions, whether that be simple compliance or full sustainability.

Implementation methodology was another area of difference. Most airports used a cross-functional team that drew from operations and maintenance staff to implement their EMS. The use of a cross-functional team appeared to be a clear precursor to the achievement of the desired benefits. Some airports even included external stakeholders, tenants, and other operators in their implementation efforts.

The airports were asked to identify their greatest barriers to implementation. While cost and resources were most frequently cited, line management resistance was another frequently cited barrier. The most consistent answer of how this barrier was overcome was time and experience with the EMS.

Although this synthesis established the benefits of EMS and the state of current practices in the airport industry, it left some questions unanswered—what best practices are and how they may make a difference in performance, addressing barriers, and aligning outcomes with intent. The survey hints that broader involvement from outside the environmental staff to maintain the EMS may be one component. Further study would be required to examine this issue. Another area for further study would be the use of EMS to promote and manage sustainability. While airports report using the EMS for this, it is not clear how they do it. As more airports address this challenge, information on how an EMS can be used to provide structure to the process would be beneficial.

Cost information, while requested, was inconsistent and/or not available. This most likely is reflective of different scopes and scales of the EMS and the approaches taken to implement them. Further study among the airports surveyed would be required to make meaningful cost comparisons and provide better information to the industry.

CHAPTER ONE

INTRODUCTION

Airports are implementing environmental management systems (EMS) to manage critical and complex issues of environmental performance and compliance. The status of current EMS practices at airports, though, has not been well documented. Individual airports may have provided information on their approaches and the content of their systems, but a comprehensive understanding of what the industry is doing was not available. This study was undertaken to answer the basic questions of why, what, and how with regard to EMS practices at North American airports.

STUDY METHODOLOGY

The study is based on a literature review of EMS practices generally, a telephone interview with 20 airports, and a follow-up web-based survey completed by 19 of these airports. The airports that were interviewed and then surveyed had experience with or knowledge of EMS, with two case studies conducted of select airports that participated in the survey.

Literature Review

An initial literature review was undertaken to help shape the survey. After the survey, the literature review was expanded to supplement the survey findings. Relevant information from the literature survey is included here and referenced in this report. All documents reviewed in the literature search, whether referenced or not, are listed in the Annotated Bibliography.

Environmental Management System Background

The concept of an EMS is coming into widespread use. EMS is a structure that organizes and ensures that an organization manages its operations that have potential environmental effects and its regulatory compliance obligations (ISO 14001 2004). The managed effects can be negative, such as air emissions; or positive, such as elimination of greenhouse gas emissions. EMS models are typically based on the plan-do-check-act (PDCA) model (Figure 1). The PDCA model is a management system concept that proposes that through continual cycles of planning, implementation, re-checking the plan, and adjustments based on the checks, will lead to continual improvement for any area of management focus (EPA 2011).

Any organization in any sector can implement an EMS. In 2007, President George W. Bush issued Executive Order (E.O.) 13423, "Strengthening Federal Environmental, Energy and Transportation Management," which requires all federal agencies to establish an EMS as the framework to manage and continually improve sustainability practices. In October 2009, President Barack Obama issued E.O. 13514, "Federal Leadership in Environmental, Energy and Economic Performance," reiterating the EMS requirement. In response, all federal agencies, including the FAA, have implemented EMS.

Environmental Management System Models Overview

"ISO 14001: Environmental management system—Requirements and guidance for use" (ISO 14001 Standard), developed internationally, is the best known model for an EMS and is generally considered a best practice. In the ISO development process, once a standard is requested by stakeholders, and if the technical committee members from participating nations agree, the standard is developed by a panel of international experts using a consensus process (www.iso.org 2011). ISO 14001 was first published in 1996 and revised in 2004. It is currently undergoing a third revision process. Organizations that implement an EMS consistent with the ISO 14001 Standard can choose to be audited and certified by an independent accredited certification body (CB), also known as a registrar. The accreditation of CBs is overseen by national accreditation bodies (ABs) (see Figure 2). As of December 2010, more than 250,000 ISO 14001:2004 certificates had been issued in 155 countries and economies, a growth of 12% since 2009 (www.iso.org 2011).

The EPA has developed a basic EMS structure that focuses primarily on setting objectives and targets, developing programs to achieve them, and monitoring the programs' effectiveness. While not so robust as ISO 14001, the EPA EMS is structured in the PDCA format. EPA also recognizes ISO 14001 as a standard which meets its definitions of an EMS. No third-party certification is included as a requirement of the EPA (www.epa.gov 2011).

The FAA issued an agency-wide requirement, "Order 1050.21," for the development of an EMS at all of its operations (FAA 2007). The order was issued in response to Executive Order 13423. To support this directive, the FAA developed "Key Elements of an EMS," that identifies elements that it expects for FAA operations (FAA n.d.). The FAA guidance closely follows the elements included in the ISO 14001 Standard but does not include many of the specific

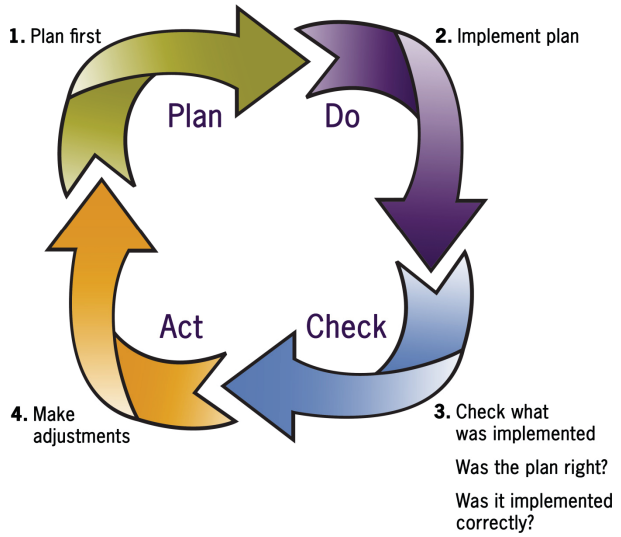

FIGURE 1 Plan-do-check-act model.

requirements. For example, the FAA does not require third-party certification. In 2007, FAA issued "Advisory Circular (AC) No 150/5050-8" to provide guidance on developing EMS to airport sponsors using federal money. It directs airport sponsors to use an existing standard and refers to the EPA and ISO 14001 Standards, specifically.

The "Eco-Management and Audit Scheme (EMAS) Standard" is another EMS standard that is broadly used in Europe. It was developed by the European Commission in 1995 and has a heavy focus on monitoring and reporting of environmental performance. EMAS includes a third-party registration scheme similar to ISO 14001. Originally open only to organizations with operations in European Union countries, registration has since been opened to all organizations regardless of location. EMAS registrations are reported at more than 8,000 by the end of 2011 (http://ec.europa.eu/environment/emas/2012).

FIGURE 2 ISO 14001 registration scheme.

Some industries set up industry-specific EMS Standards. Examples of these are the Responsible Care Standard for the chemical industry and the Recycling Industry Operating Standard. These are both based on the PDCA model and have a great deal of similarity to ISO 14001 with industry-specific issues added.

ISO 14001 Overview

This study was not focused on a particular EMS model, but was instead based on the broader concept of systems that are used to manage environmental performance. However, to provide a better understanding of a typical structure of an EMS, an abbreviated explanation of the ISO 14001 EMS requirements has been provided here (see Figure 3). It should be understood that this is an example and that airports may have EMS structures that differ from this or that do not include all of the elements in ISO 14001 Standard.

Scope

As part of the general requirements, organizations need to define the scope of their EMS. Since an EMS can apply to a single operation, a single facility, multiple facilities, or even an entire organization, it is necessary to define exactly what operations are and are not included in the EMS.

Commitment and Policy

Development of an EMS starts with an environmental policy. The organization must define and commit to a policy that is relevant to the nature, scale, and environmental impacts of the activities it conducts, the products it supplies, and/or the services that it renders. To conform to the ISO 14001 Standard, the policy, at a minimum, needs to include commitments to prevention of pollution, compliance with environmental laws and regulations, and continual improvement of the EMS. The environmental policy establishes an overall sense of direction.

Planning

Information and data gathered during the planning components feed into the rest of the EMS. For example, one of the initial efforts for the organization is the identification of any environmental aspects associated with the organization's activities, products, or services that can interact with the environment, and the differentiation of those that are potentially significant. The organization must also identify any potential environmental impacts—that is, is any change in the environment, wholly or partially resulting from the organization's activities, products, or services—whether positive or negative.

During this stage, any legal or other requirements to which the organization is bound are identified. Other requirements

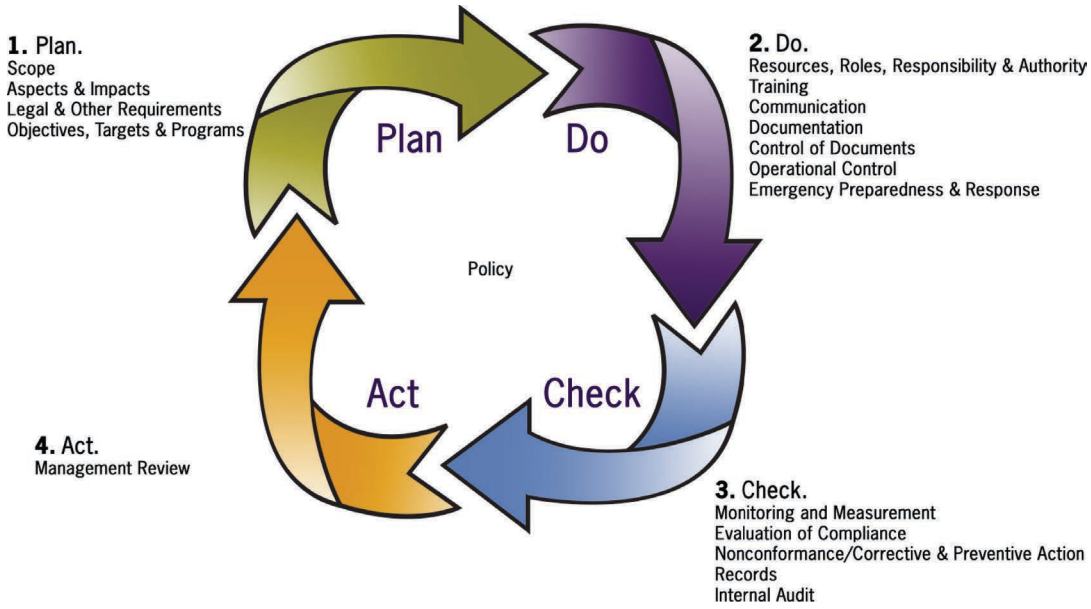

FIGURE 3 Typical components of an EMS based on the ISO 14001 elements.

may include internal commitments, such as a green purchasing requirement; or external commitments, such as a commitment to report on environmental performance using the Global Reporting Initiative (GRI) Framework, a comprehensive set of sustainability measures (GRI 2006). Objectives and targets consistent with the environmental policy are then developed to address significant impacts on the environment, followed by plans and associated schedules, resources, and responsibilities to achieve the environmental objectives and targets (see Figure 4).

Implementation and Operation

As part of this element, resources, roles, responsibilities, and authorities for the EMS are defined, along with requirements for training, awareness and competence training. Procedures are implemented for communication, both internally and externally, related to the environmental activities of the organization; to demonstrate management commitment; and to address concerns and questions, raise awareness, and provide information about the organization's environmental performance.

Documentation of EMS elements, in the form of a manual or a set of linked procedures, documents, and records, is outlined. Document control procedures ensure that documents can be located, periodically reviewed, and kept current; are understandable, dated, and readily identifiable, and maintained in an orderly manner. Following identification of the operations and activities at the organization that are associated with significant environmental aspects, operational control ensures the

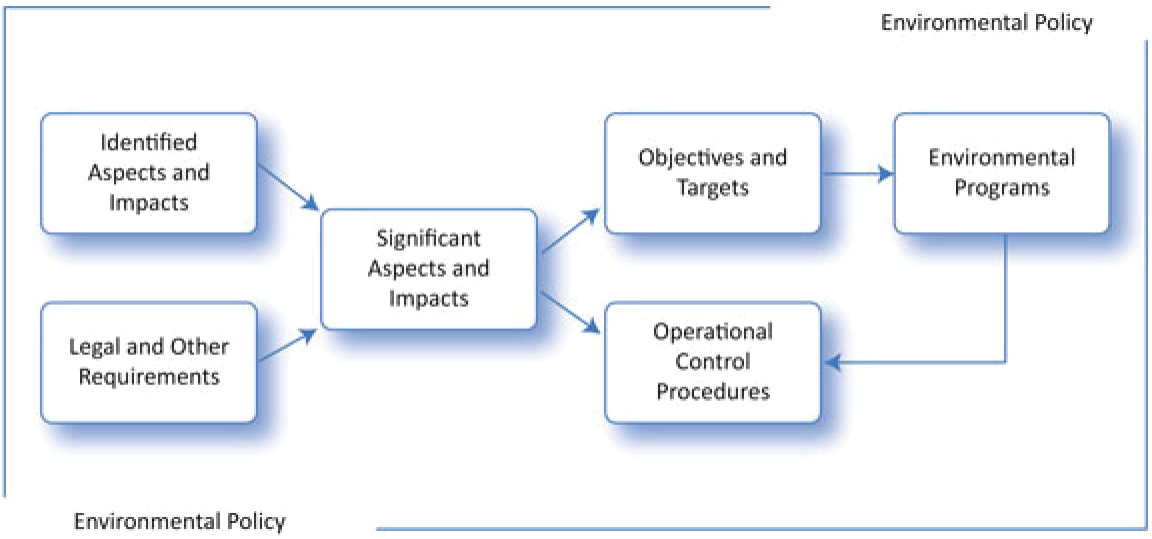

FIGURE 4 Relationship of ISO 14001 components.

Several types of audits can be used to monitor management system and performance:

Compliance Audits are used to check compliance with regulatory and other requirements.

Management System Audits are used to check conformance either to the relevant standard or to the defined requirements of the management system.

Audits are also classified by who performs them.

First Party Audits are audits that are performed by the organization on itself.

Second Party Audits are those performed by a party with an interest in the audited organization, such as a customer or regulator.

Third Party Audits are those performed by an independent organization such as a CB (registrar).

organization carries out its operations and activities (including maintenance) under specified conditions. Documentation procedures are developed if their absence could lead to deviations from the environmental policy and the objectives and targets. Emergency preparedness and response planning ensures appropriate reaction to unexpected incidents or accidents.

Checking and Corrective Action

The monitoring and measurement element requires that the organization measure, monitor, and evaluate its environmental performance and the functioning of the EMS, and is used to ensure the reliability of equipment or systems providing the data. Evaluation of compliance requires that the organization periodically evaluate and/or audit compliance with relevant environmental legislation and regulations and other requirements to which the organization subscribes. Critical to ensuring the continual improvement of the EMS is what is termed the nonconformance and corrective and preventive action process, which investigates and corrects potential and actual deviations from the requirements of the management system as well as correcting and addressing the underlying or root cause of the nonconformance. The organization also develops procedures for the identification, maintenance, and disposition of environmental records. The requirement to establish and maintain a program for periodic internal audits serves as a check on the entire EMS.

Management Review

Management review closes the continual improvement loop by requiring that top managers periodically review the EMS to ensure its continuing suitability, adequacy, and effectiveness.

SURVEY METHODOLOGY

With assistance and guidance from the Topic Panel, 20 United States and Canadian airports with experience and/or knowledge of EMS were identified for possible participation. Effort was also made to include a variety of types of airports. The identified airports were asked to participate in a telephone interview during the months of June and July 2012 to determine if they had considered developing an EMS and if they would be willing to participate in an electronic survey. The electronic survey, developed based on the results of the literature review, was not designed to reflect a particular EMS standard but instead took a more generic approach, reflecting commonalities among the various standards. Topic Panel members responded to the telephone interview and the electronic survey/questionnaire, and their comments were incorporated prior to distribution. (Appendix A contains the telephone survey and the electronic survey/questionnaire and results.)

Nineteen of the 20 airports completed the follow-up electronic survey in July and August 2012. (Appendix B lists participating airports.) The answers were self-reported and no independent verification of the answers was undertaken. The survey was "tiered" and the airports answered only those questions that applied based on their preceding answers. Questions asked for both qualitative and quantitative data. Owing to the sample size, responses are shown by the number of airports that responded and not percentages.

A few airports asked to see the survey in its entirety before responding so that their answers could be compiled, if necessary, with other management or other parts of the organization. Hard copies of the electronic survey were provided as requested, and the airports responded electronically. In one case, the airport was in its initial phase of considering an EMS and requested to supply a limited response identifying only the drivers for considering an EMS. This was accepted as it provided substantive information for the synthesis. Some follow-up with individual airports was undertaken in August 2012 to clarify answers and develop the two case studies.

Analysis of Questionnaire

The results of the airports survey were aggregated for analysis purposes. Some survey questions required a qualitative ranking of the respondents perceived degree of importance. To

Transforming the qualitative ranking into a quantitative ranking was done by assigning numerical values to indicate varying degrees in the qualitative response. For example, a question on benefits was scored as followed:

- No benefit = 1
- Moderate benefit = 2
- Significant benefit = 3

better assess the collective responses to these types of questions, those survey results were translated into quantitative measures. In some cases, question results were compared to others to test possible relationships. Where correlations were identified, elaboration is provided.

The results of the surveys and case studies have been synthesized in this report in the following chapters:

- Chapter Two—Survey Respondents
- Chapter Three—Current Practices and Challenges
- Chapter Four—Environmental Management System Framework
- Chapter Five—Similarities and Differences in Approach and Content
- Chapter Six—Lessons Learned
- Chapter Seven—Conclusions and Knowledge Gaps.

These chapters provide practical information from their peers that airports can consider in making the decision to develop an EMS.

CHAPTER TWO

SURVEY RESPONDENTS

The survey attempted to include a variety of different types of airports. Provided here is information on the size and location of the surveyed airports and their status with regards to EMS implementation (Figure 5). The majority of airports that responded and provided substantive information are classified as large hubs by the FAA. A smaller group of five is classified as medium hubs, and two are classified as small hubs. Many of the airports have a large freight component. Seven respondents are among the top 50 airports in the world based on tonnage according to Airport Council International (http://www.aircargoworld.com/Air-Cargo-News/2011/08/the-worlds-top-50-airports/251575, Aug. 25, 2011). The attempt to include a non-hub airport was unsuccessful, and therefore, none is included in the survey results.

Geographically, the airports are spread throughout the United States and Canada, as shown in Figure 6.

Of the 19 airports that responded, 13 have either developed or are in the process of developing an EMS. Four are evaluating the possibility. One discontinued its attempt and the remaining airport has decided against implementing an EMS; see Table 1.

Many of the airports surveyed were early adopters of EMS: The ISO 14001 Standard has only been in place for 16 years, yet one airport reports having been certified for 15 years. Of the 12 airports surveyed with an EMS in place, the age of the EMS ranges from two years to 15 years and averages over 7½ years, going back more than two years before the FAA began to provide funding for EMS.

According to the survey, it took airports between nine months and slightly over four years to develop and implement the EMS. The median time to develop and implement an EMS was two years. Of those who sought ISO 14001 certification, all took two years or more. No correlation existed between the size of the airport and the time to develop the EMS (correlation coefficient 0.34). However, the number of significant benefits reported by the airports (see chapter five) positively correlated with the number of years the EMS had been in place (correlation coefficient 0.74).

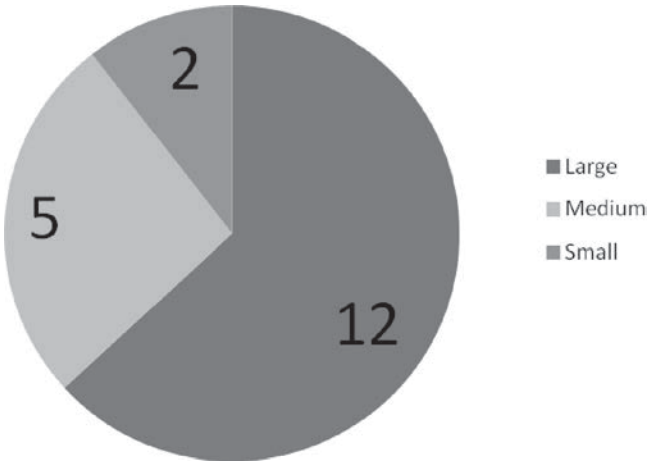

FIGURE 5 Size distribution of airports.

FIGURE 6 Map of survey respondents.

TABLE 1
SURVEY RESPONDENTS' EMS STATUS

Status of Environmental Management System	No. of Airports
Considering or thinking about an EMS	4*
Developing an EMS	1
Have developed an EMS	12
Considered or thought about it and rejected implementing an EMS	1
Discontinued development of an EMS	1
Total	19

*Includes airport that provided a limited response.

CHAPTER THREE

CURRENT PRACTICES AND CHALLENGES

The initial decision to develop an EMS or to decide against it—and what informs that decision—is a critical question in evaluating the status of EMS practice (Yin and Schmeidler 2007). This chapter provides an overview of issues related to the decision to develop an EMS. It examines the reasons to proceed with an EMS (or if not, why not), and the motivations for development.

The issues surveyed in the decision to implement or not implement an EMS include:

- drivers for consideration;
- reasons that influenced the decision not to develop an EMS;
- primary purpose of the EMS; and
- cost of development.

ENVIRONMENTAL MANAGEMENT SYSTEM DRIVERS

The airports were asked to rank the importance of certain issues that affected their decision to consider implementing an EMS (see Figure 7). All 19 airports responded.

Improved environmental performance was ranked highest, with all 19 of the airports identifying it as either very important (15) or important (four). The airports gave relatively similar weight to improved employee understanding of environmental issues and responsibilities, environmental risk reduction, compliance concerns, and improved internal process.

Leadership in industry, airport management interest, public or environmental organization interest, cost reductions, and improved regulator relationships, although ranked lower, were fairly consistently rated between somewhat important and very important. Tenant or customer interest, and elected or appointed official interest formed the third tier.

The airports gave the least weight to regulator requirement, with more than half of the airports indicating that no regulator requirement, such as an administrative consent order, was associated with their reason for developing an EMS. However, three airports ranked it as very important and two as important, indicating that a regulator requirement can be a strong driver when it is applicable to a particular airport.

The results indicate that while compliance was important, many airports are looking to achieve broad benefits from their EMS. This is supported because 11 of 16 airports that are considering or have made the decision to implement an EMS indicated that the primary purpose of their EMS was to move beyond compliance issues.

DECIDING AGAINST AN ENVIRONMENTAL MANAGEMENT SYSTEM

Only two of the 19 respondents that responded to the survey decided not to develop an EMS. This sample size is too small to draw a conclusion regarding the reasons airports in general might select against implementing; however, the answers (Figure 8) provide some insight into their possible thinking.

Major reasons for not implementing focused on the time, amounts of documentation and paperwork, and manpower requirements. That these airports also report having sufficient programs in place would appear to buttress their conclusion that the effort was not justified. Lack of senior management support and potential cost, although ranked as somewhat important, were nevertheless ranked lowest of the reasons given. One of the airports that decided against implementing an EMS indicated it may reconsider the decision in the future.

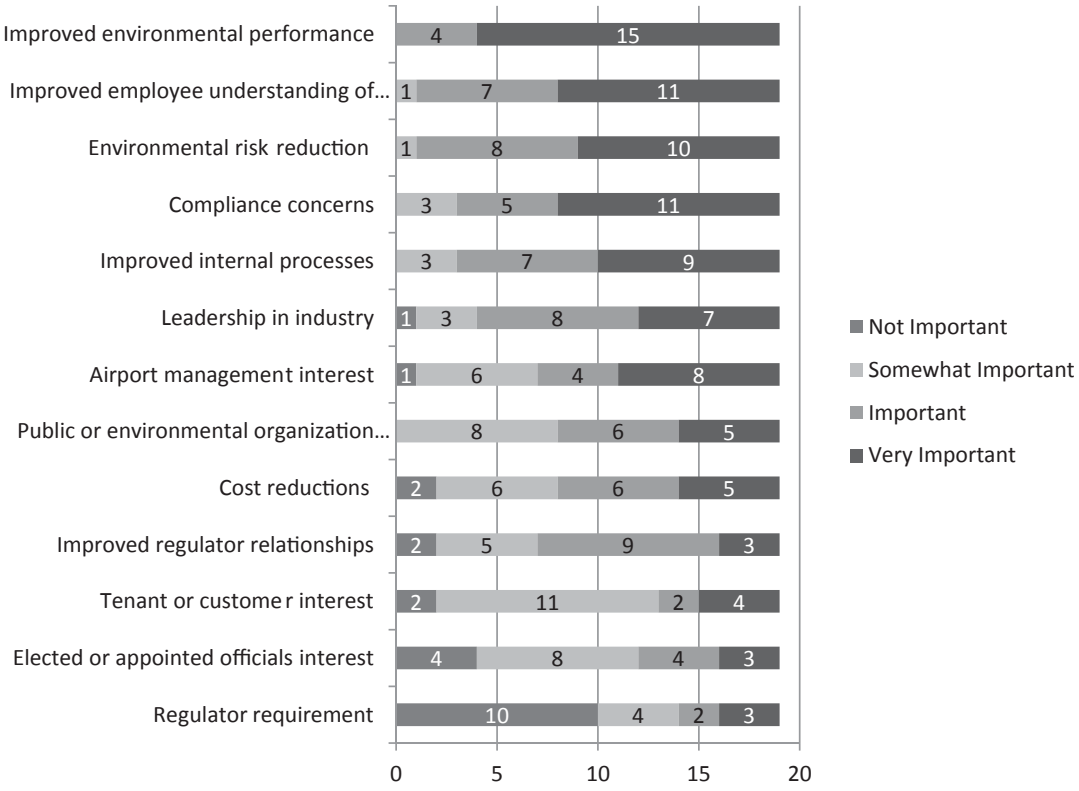

FIGURE 7 EMS drivers.

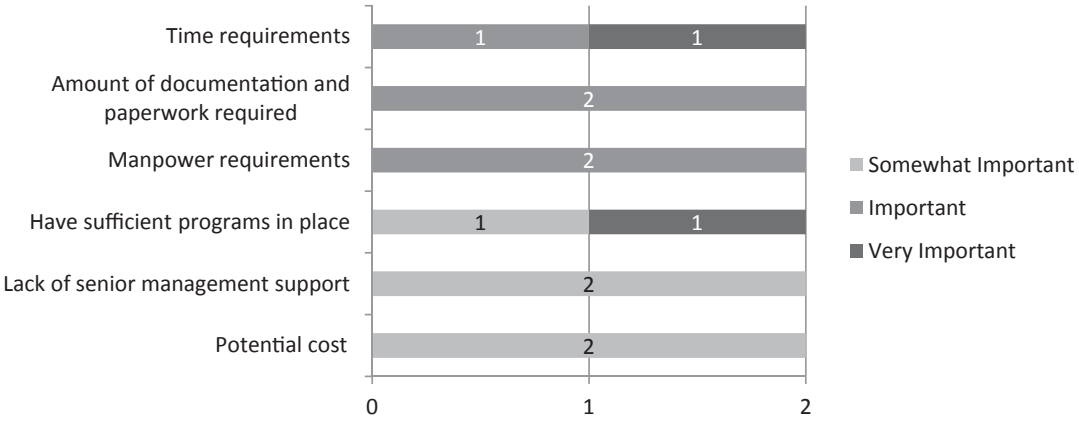

FIGURE 8 Deciding no.

CHAPTER FOUR

ENVIRONMENTAL MANAGEMENT SYSTEM FRAMEWORK

EMS adopters have numerous choices to make with regard to the overarching structure of the program. This chapter describes the framework options that the airports who decided to implement EMS have selected, including:

- use of the PDCA concept;
- use of the ISO 14001 standard;
- decision to certify to ISO 14001; and
- environmental and sustainability issues addressed with the EMS.

PLAN-DO-CHECK-ACT FRAMEWORK

In general, the framework of EMS for respondents who are considering implementing, or have implemented EMS, are based on the PDCA model that is also incorporated in the ISO 14001 EMS standard. All of the airports surveyed that have an EMS, are developing an EMS, or are considering an EMS—with the exception of one—are using or will use the PDCA model. The exception airport is considering or thinking about an EMS and it did not indicate whether another standard will be used.

USE OF THE ISO 14001 STANDARD

Of the 16 airports who have implemented, are implementing, or will implement an EMS (excluding the airport that provided a limited response), 12 are using the ISO 14001 EMS Standard for their EMS framework. This included all but one of the airports with an EMS in place. The four airports that are not using ISO 14001 did not identify another standard, such as EPA's model.

Half (six) of the 12 airports that have an implemented EMS are ISO 14001 certified. No correlation appears to exist between the size of an airport and decision to be certified. Nor was there a correlation between airport geographic area and certification, as certified airports were scattered across the United States and Canada.

When asked to rank the value of their ISO 14001 certification, those airports ranked credibility and independent confirmation of EMS effectiveness as the most important benefits, as shown in Figure 9. This was followed by better rate of improved performance. Better employee buy-in was also recognized as a benefit of ISO 14001 certification.

Among those ten airports that reported not seeking certification, the highest ranked reason was cost (Figure 10); the next most important reason was the time required. This was followed by no value in being certified, although one airport indicated that there may be some value. The lowest ranked reason was no need for independent review, indicating that at least three airports might have seen some benefit in an independent review.

ENVIRONMENTAL ISSUES

The 16 airports that have developed or are considering developing an EMS manage a variety of environmental and sustainability issues in their facilities.

All airports identified spill avoidance and response, and stormwater management. All but one airport identified hazardous or universal waste management and recycling as included in the EMS. Fourteen airports address solid waste management, chemical storage and use, and air emissions. Clean and alternative fuel fleets and vehicles, and fuel and petroleum storage and use were addressed by 13 airports; energy use and efficiency by 12. Greenhouse gas emissions, deicing, and water use and conservation were identified by 10 airports; sustainable design and development, and renewable energy by nine. Resource usage, green buildings, green purchasing, environmentally sensitive habitats and receptors, endangered species, and noise were all identified by half of the airports. Seven airports included land use planning, alternative and renewable fuels, and wetlands; six listed climate change mitigation and purchasing; and four included climate change adaptation. As "other" issues, one airport identified remediation and another airport listed avoidance of pesticides.

As shown in Figure 11, traditional compliance-related environmental issues were universally included in the EMS. However, half or more of the airports also include sustainability initiatives such as reduced greenhouse gases and green building, which reflect a broader intent. This is supported by the self-reported desire of over half the airports responding to go beyond compliance with their EMS. One airport included management of all issues identified in the survey in its EMS. A second included all but deicing, which it reports that it does not perform because of its climate.

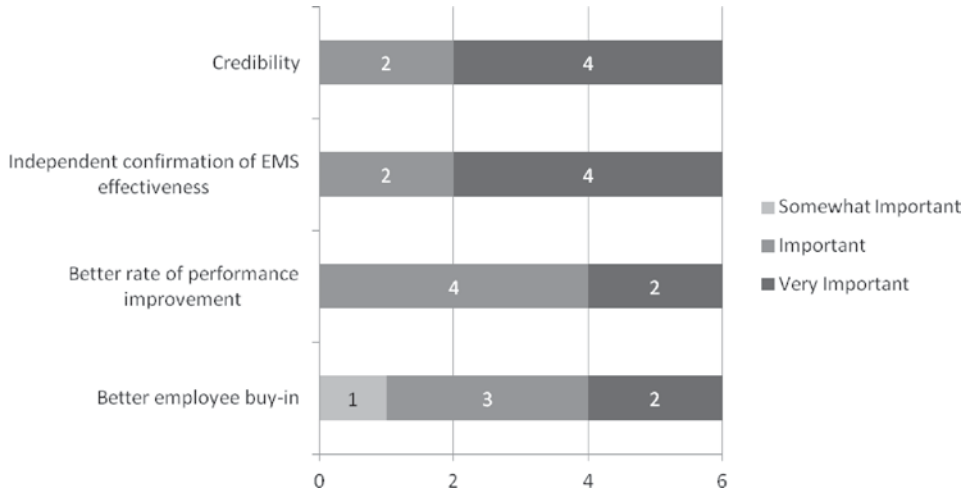

FIGURE 9 Use of the ISO 14001 standard.

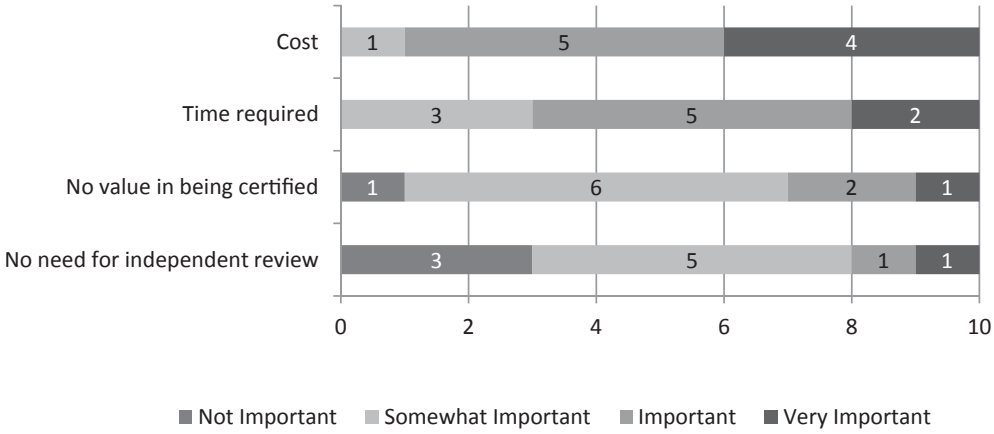

FIGURE 10 Reasons for not seeking ISO 14001 certification.

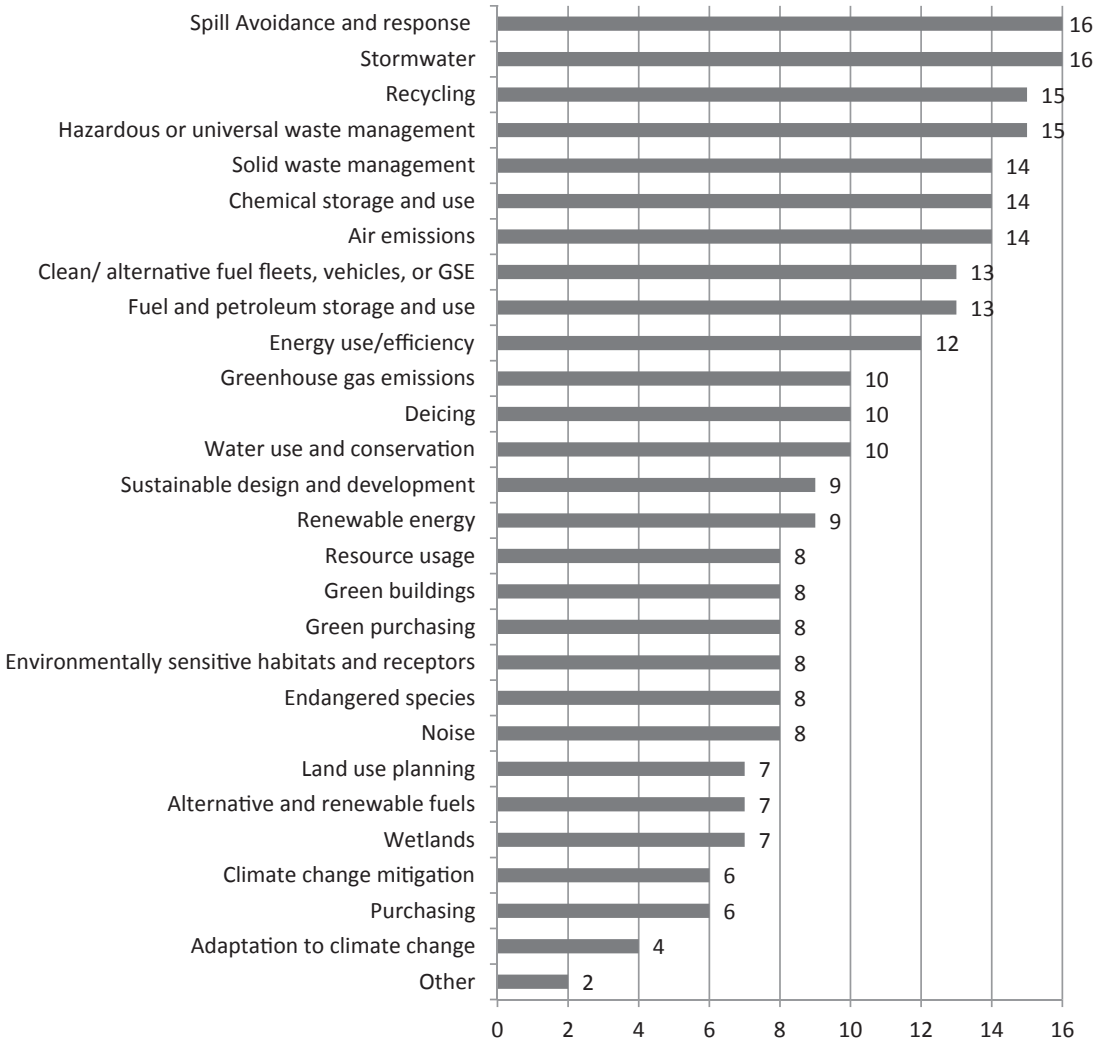

FIGURE 11 Issues managed within the EMS.

CHAPTER FIVE

SIMILARITIES AND DIFFERENCES IN APPROACH AND CONTENT

IMPLEMENTATION PROCESS DIFFERENCES AND SIMILARITIES

The airports reported using different implementation approaches for their EMS. Resources used to implement their EMS varied as shown in Figure 12.

Fifteen of the 16 airports that are considering, implementing, or have implemented an EMS used or will use internal environmental staff. The one airport that reported not using internal environmental staff used a cross-functional development team, as did (or will) nine other airports. The use of a cross-functional team in developing an EMS was highly correlated with the answers for important benefits reported to have been achieved with the EMS (correlation coefficient 0.81). Thirteen included or will include their operations and maintenance staff in the implementation effort. However, including operations and maintenance staff did not appear to correlate with the number of benefits achieved. Three EMS included tenant representatives and/or stakeholder representatives in the effort. External resources included, or will include, consultants (11), training (five), and the purchase of EMS templates and software (three). One airport reported using internal training and another used internal consultants from the government entity of which it is a part.

In general, of the 12 respondents with an EMS, the environmental group was most often identified as responsible for developing the EMS. For one airport, however, the fueling facilities and civil environmental engineering group was primarily responsible for EMS development; for another, the public works and transportation department group was responsible.

The survey attempted to collect the cost of development and implementation, including internal labor costs, internal man hours, external costs, consultant costs, and hardware and software costs, from all airports that developed an EMS. Only half of these airports provided information on these costs, and responses were incomplete. However, internal labor costs were reported at under $100,000, although it is not clear if this was for both development and implementation or simply implementation. As for internal staff hours, the responses ranged from unknown to about two full-time equivalents (FTEs), and up to 20,000 and 45,000 hours. The high labor hours were associated airports with larger staffs.

CONTENT DIFFERENCES

Specific elements or components of an EMS can vary. While the elements of each EMS vary slightly by airport, how each element is addressed shows greater variety.

The survey found that all 16 airports that were considering, developing, or had developed an EMS had most, if not all, of the elements identified as part of a generic EMS. Table 2 identifies the elements and quantifies how the airports include each element.

Seven of the 12 airports that have implemented EMS include all the elements listed. Five of them did not identify

Case Study: Incremental vs. Universal Implementation

The cost to develop an EMS can vary broadly based on the magnitude of the system and the approach taken. Boston Logan (BOS) implemented an ISO 14001 EMS using a relatively low budget of $60,000, $10,000 of which was spent on internal labor and $50,000 that was spent on a consultant and a registrar. Boston Logan's EMS, which was developed as part of Massport's EMS Program, was limited to only part of its operations, the HVAC and boiler plants. The airport plans to expand its EMS incrementally facility by facility. This approach allows BOS to pilot an EMS and then cost-effectively expand the pilot to include other operations.

The EMS developed at Dallas Love Field (DAL) is also ISO 14001 certified. It was developed as part of a massive city-wide effort to certify all Dallas government operations to ISO 14001. The cost for developing and implementing the entire city of Dallas EMS, covering 11 city departments and approximately 11,000 of the city's 13,000 employees, was $11,000,000. It included not only DAL but all city operations, such as water and wastewater treatment, and solid waste operations. During development of the EMS, DAL assigned two people full-time to the project. The city of Dallas Office of Environmental Quality (OEQ) had ultimate responsibility for developing the city-wide EMS. The $11,000,000 included all of the costs for the consultant, registrar, hardware, software, and licenses.

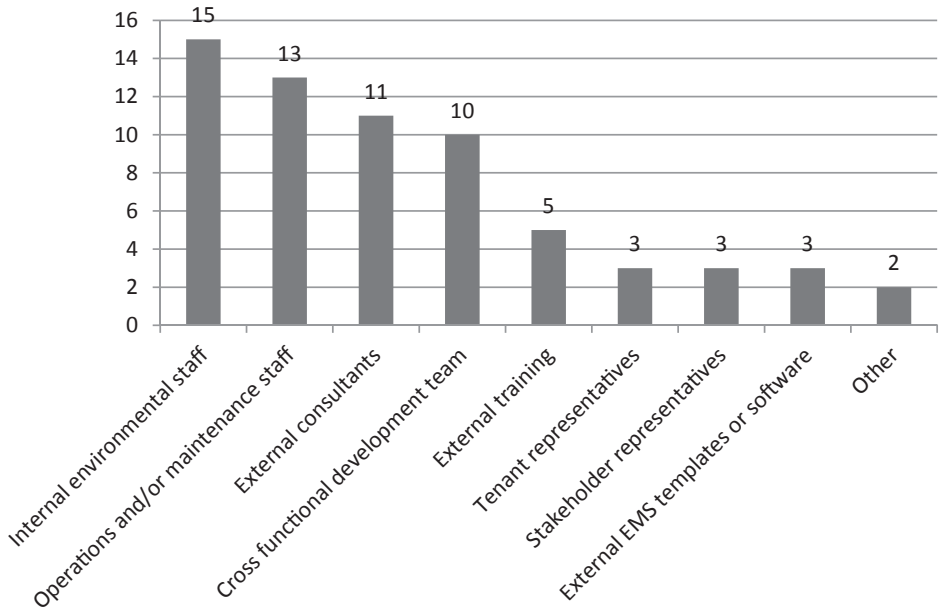

FIGURE 12 Resources used to implement the EMS.

external communications; four of those also reported that they did not include other elements. For example, two did not include work procedures or instructions. One airport did not include identification of impacts or risks, legal requirements, and emergency planning and response. Another airport did not include a management review.

Each element in the generic EMS structure was then further examined for similarities and differences. The elements were set out fairly similarly to the structure of ISO 14001, as the PDCA structure is universally recognized as the appropriate structure for management systems. It is important to note that including all of the generic elements in their EMS does not necessarily mean the airports have met the ISO 14001 requirements (see chapter one, EMS Models). For discussion purposes, those who report that they include an element in their EMS, or intend to include an element in their EMS, are reported together with no differentiation.

TABLE 2
SIMILARITIES AND DIFFERENCES IN EMS CONTENT

EMS Components	Considering or Thinking About an EMS		Developing an EMS		Have Developed an EMS		Total	
	Yes	No	Yes	No	Yes	No	Yes	No
Policy	2	1	1	0	12	0	15	1
Identification of Impacts or Risks	1	2	1	0	11	1	13	3
Legal Requirements	3	0	1	0	11	1	15	1
Goal Setting	2	1	1	0	12	0	15	1
Defined Roles and Responsibilities	3	0	1	0	12	0	16	0
Training: Awareness and Competency	3	0	1	0	12	0	16	0
Internal Communication	3	0	1	0	12	0	16	0
External Communication	3	0	1	0	7	5	11	5
Work Procedures or Instructions	1	2	1	0	10	2	12	4
Emergency Planning and Response	1	2	0	1	11	1	12	4
Monitoring and Measurement	3	0	1	0	12	0	16	0
Audits	2	1	1	0	12	0	15	1
Preventive and Corrective Action	2	1	1	0	12	0	15	1
Records and Documentation	3	0	1	0	12	0	16	0
Management Review	3	0	1	0	11	1	15	1

Source: First Environment, Inc.

Case Study: Assessing Aspects/Impacts/Risks—A Tale of Three Airports

The approach to the identification of aspects and impacts of environmental risks varies widely. Some airports use a carefully defined quantification methodology while others use a more qualitative methodology. Some use cross-functional teams to evaluate and some limit assessment to the environmental department.

At Toronto (YYZ), an ISO 14001 certified airport, the environmental department reviews the airport aspects yearly, examining any issues associated with the aspect that has occurred in the last year. The issues are then scored to determine those which are significant. The scoring addresses two components, the environmental risk and the business risk. Sub-categories under each type of risk are scored 1 to 5. Any aspect with an average risk of 3 or above is considered significant. No positive aspects are included.

Miami Airport (MIA), also certified to ISO 14001, uses a qualitative method. Managers and personnel of various operations review their operations and identify areas of concern which are then considered significant. Miami includes positive as well as negative aspects in its assessment.

Philadelphia has an EMS that is compliance focused. The EMS is not based on ISO 14001 or any other standard. To identify their environmental risks, they review their regulatory permits and National Environmental Policy Act (NEPA) issues. These are then ranked for importance by all of the departments at the airport, considering the regulatory and sustainability concerns associated with them. No positive impacts are included in the assessment.

Policy

All airports reported having an environmental policy except for one which is considering developing an EMS. This would indicate that most EMS do include a policy to set the expectations for the EMS.

Environmental Impacts or Risks Identification and Evaluation

Thirteen of 16 airports include identification of environmental impacts or risks in their EMS. Of the 13 airports that identify environmental impacts or risks:

- All the airports identify the negative environmental impacts or risks.
- Ten airports evaluate them quantitatively and three do not.
- Approximately half include tenants' and operators' impacts and risks.
- More than two-thirds include contractors' impacts and risks.
- Ten airports include the positive environmental impacts; three do not.

Legal Requirements

Fifteen of the 16 airports list legal requirements as part of their EMS. Of those 15:

- Twelve provide compliance support to tenants and operators. In nine cases, this includes compliance training, as well as tools and procedures.
- Ten also provide compliance support to contractors. Of these,
  - six provide regulatory training, and
  - nine provide tools and procedures.

Goals

Fifteen of the 16 airports report goal-setting as an element in their EMS. Of those:

- All include measurable environmental performance goals. The metrics used are specific to the goal.
- Five include ACI-NA environmental goals.
- The frequency with which goals are set ranges from quarterly to biannually, with the most frequent interval being yearly. Twelve of the 15 include the goal setting in the yearly planning and budgeting process, which is an indicator of integration of the EMS into airport activities.
- Responsibility for achieving goals is shared with operations and maintenance personnel in 14 cases.
- At five airports, responsibilities for goals are also assigned to tenants and other operators, which is an indicator of a broad approach to the scope of the EMS.

Roles and Responsibilities

All 16 airports reported assigning roles and responsibilities in their EMS:

- The majority, 11 airports, report assigning EMS responsibility between environmental and operations and maintenance staff. However, of the 12 with implemented EMS, five report that in actuality the environmental department takes on most of the responsibility.
- Environmental staff is assigned the greatest responsibility for the EMS at four airports.
- Operations and maintenance is assigned the major responsibility at one airport; however, it reports that in actuality responsibilities are broadly shared.
- Five airports include EMS responsibilities in job descriptions. Five include a designated contact for tenants and

Case Study: Westchester County Airport—A Technical Committee Structured to Meet the Strategic Intent of the EMS

Westchester County Airport, which includes general and commercial aviation operations, has been operating since 1949. The airport is located partially within a watershed associated with a New York City and Westchester County drinking water reservoir. This results in a complicated regulatory regime involving the EPA, New York State Department of Environmental Conservation, New York City Department of Environmental Protection, and the Westchester County Health Department. It is located within three municipalities, further adding to the complexity of compliance. Additionally, the airport exists in a community where the environment and its protection are highly valued.

As a result of these issues, the airport exceeds its regulatory requirements with a long-standing groundwater monitoring program and a voluntary restraint-from-flying program that includes extensive community noise monitoring. It has also set up an airport advisory committee made up of stakeholders within the community. In 2001, in further response to community concerns, the airport committed to the development of an ISO 14001 EMS that would ensure stakeholder confidence in the environmental management of this facility and would include all parties that have the potential to impact the environment at the airport.

It was decided that all airport operations, along with those of air carriers, tenants (FBOs, car rentals, corporate facilities, ground support, etc.), contractors, vendors, and eight county departments with airport responsibilities, would be included to meet the goal of exceptional environmental performance. A technical committee was set up to provide broad oversight and strategic direction to the EMS. The members included representatives from each of the eight county departments with airport responsibilities (planning, public works, public safety, health, environmental facilities, law, transportation, and information technology), a major tenant representative, an airline representative, the chairman of the airport advisory committee, and airport officials, including the environmental manager.

The county department representatives were appointed by their respective commissioners and were responsible for ensuring the training and implementation of the EMS by their employees with airport responsibilities. The tenant and airline representatives articulated the broad interests of their groups in the decision-making process. In addition, each tenant and airline named a responsible employee who ensured that EMS training was provided and EMS responsibilities were met within their organizations. To support communication among the participants, all parties were provided access to an intranet site with tools and training. In 2005, the EMS received an Environmental Achievement Awards Honorable Mention from Airports Council International.

other operators. Most (13) include an internal cross-functional advisory team. Only one included external stakeholders on this team.

Training

All 16 airports report that they provide EMS awareness and regulatory/compliance training. Personnel who receive such training are described in Figures 13 and 14.

Internal Communication

All of the 16 airports manage internal communication within their EMS; 13 maintain a website to provide access to EMS information, either on an intranet or an internet site. All share information on environmental performance. The majority shares this information very broadly within their own operations. A few also share this information with parties such as tenants or contractors.

Of the 16 airports, environmental performance is reported to the following:

- management (15 airports),
- environmental staff (15 airports),
- maintenance staff (12 airports,
- operations staff (11 airports),
- administrative and finance staff (10 airports),
- tenants (five airports).

Individual airports also identified that they reported performance information to:

- the board of directors,
- construction consultants and contractors,
- business partners.

External Communication

Only 11 of the 16 airports include *External Communication* within their EMS. Of these airports:

- All communicate on an intranet site.
- Seven provide a public report of environmental performance.
- Four meet with tenants and other operators to report on environmental performance.
- Three make publicly available their sustainability reports.
- Three report on environmental performance at public meetings.
- One provides a report on sustainability at public meetings; and

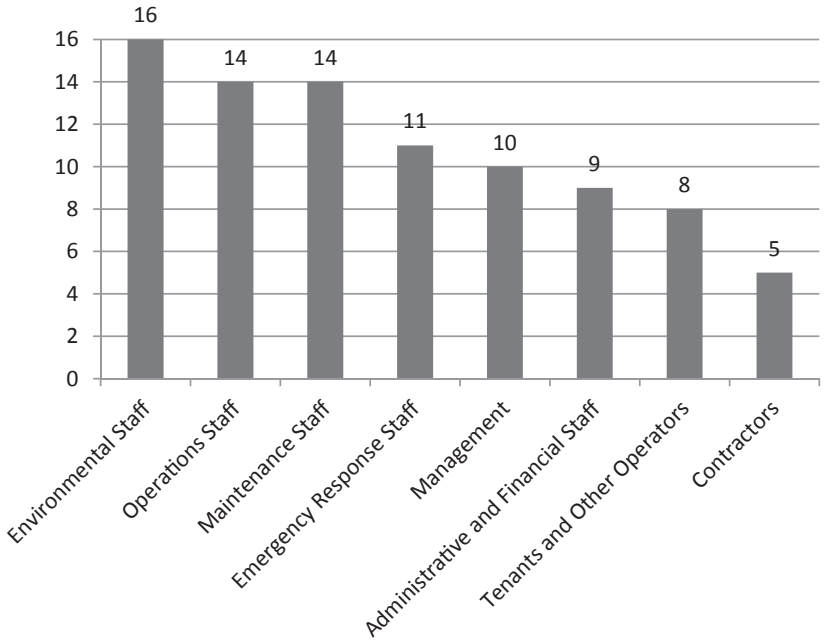

FIGURE 13 Awareness training.

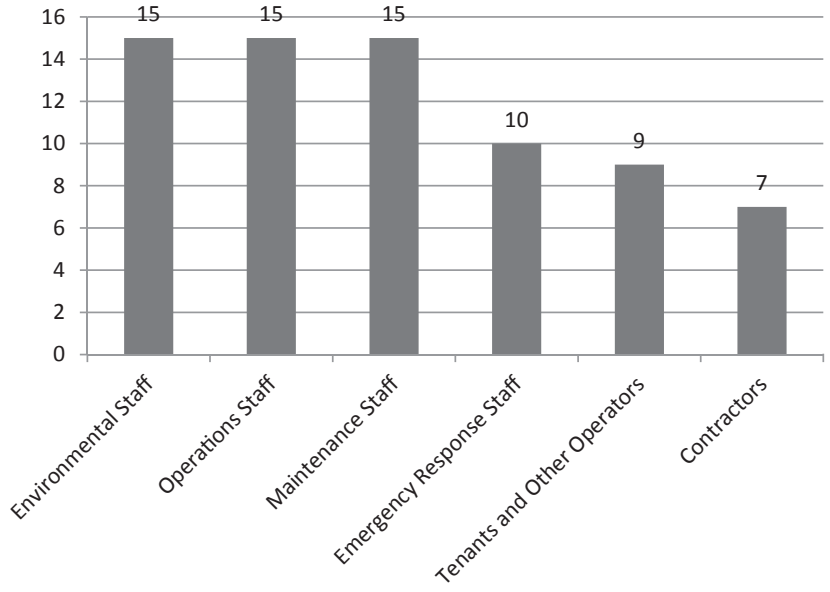

FIGURE 14 Compliance training.

Case Study: Denver—Internal Communication

Denver International Airport (DEN) has implemented a cutting-edge approach to internal communications. DEN includes its business partners in its EMS. These partners include tenants and other operators such as airlines, rental car agencies, restaurants, fuel service providers, and air kitchens at the airport. DEN routinely distributes environmental achievements and performance information to them electronically. Since these partners are within the scope of DEN's EMS, these advisories are considered internal communications. The 2011 Annual Report "*Managing the Environment at Denver International Airport"* illustrates this approach. The report addresses environmental stewardship, the EMS, environmental performance report card, sustainability with altitude, social and cultural programs at DEN, renewable energy (solar, waste management, greenhouse gases), and looking ahead. The report identifies DEN's awards and recognition for 2011, and sets out its ambitions for environmental stewardship and the objectives in this arena; for example, becoming a zero waste facility by 2020 and carbon-neutral by 2050. Specifically for the EMS, DEN identifies its significant environmental aspects. The performance report card provides normalized data for energy use, waste generation, and collection of deicing fluids, including the baseline from past performance, the goal, and the actual performance. The report also addresses the improvements planned for the coming year, and reflects DEN's view that sustainability should be fostered through its EMS. The report can be viewed at: http://business.flydenver.com/community/enviro/documents/annualReport2011.pdf.

- One prepares and submits a report based on the GRI guidelines.

Emergency Response and Planning

Twelve of the 16 airports included emergency response and planning in their EMS. Of those:

- Nine airports identified environmental related planning and response as the responsibility of both emergency response and the environmental staff.
- Two airports identified it as the responsibility of emergency response staff.
- One airport identified it as the responsibility of environmental staff; and
- Three airports include environmental personnel in Part 139 fire drills, which might be an indicator of integration of the EMS with airport operations.

Monitoring and Measurement

All of the 16 airports include monitoring and measurement of the EMS:

- Fifteen monitor and measure progress on goals.
- Thirteen monitor and measure training; and
- Thirteen monitor and measure non-compliances and/or nonconformances.

All 16 airports surveyed also collect and report environmental performance data as shown in Table 3.

Other performance measurements identified by individual airports included clean air vehicle conversions, monitoring of groundwater, site restorations, and air quality conformity. Twelve airports reported that they normalize performance data. One reports that it normalizes all performance data.

Environmental Management System and Compliance Audits

Fifteen of the 16 airports include audits as part of their EMS.

- Eleven of the 15 airports perform EMS audits of the management system.
  - The frequency of the EMS audits varies from twice annually to every three years. Five audit annually, and one uses a variable schedule.
- Twelve of the 15 airports perform compliance audits.
  - The frequency of compliance audits varies from quarterly (one airport) to every three years (three airports). Five audit annually. One reported a variable schedule.
- Six of the 15 airports require tenants to perform compliance audits.
- Eight perform compliance audits on tenants.
  - The frequency of tenant compliance audits ranges from yearly (six airports) to up to three years.
- Eleven airports evaluate audit findings for trends.

TABLE 3
PERFORMANCE MONITORING

Performance Indicators	Collect Data	Report Internally	Report Externally	Not Included
Stormwater Quality/Quantity	14	13	13	0
Spills	14	14	10	0
Recycling	13	14	10	1
Solid Waste	13	12	10	2
Air Emission	12	12	11	3
Hazardous and Universal Waste	13	10	9	2
Wastewater Discharges	12	10	9	3
Energy Conservation	11	11	8	4
Energy Consumption	12	12	6	3
Deicing Chemicals Use	10	11	7	4
Chemical Use	10	10	7	4
Water Usage	12	10	5	3
Greenhouse Gas Reductions	9	10	8	5
Greenhouse Gas Emissions	10	9	8	4
Noise Levels	9	9	8	7
Petroleum Use	8	9	7	7
Noise Complaints	8	9	6	7
Noise Mitigation Efforts	8	8	7	8
Endangered Species	8	7	7	8
Water Conservation	9	9	4	6
Green Buildings	8	8	5	8
Green Purchasing	7	7	4	8
Renewable Energy/Green Energy Production	6	7	4	9
Habitat Restoration	4	6	6	9
Fines Associated with Environmental Noncompliance	6	5	4	9
Environmentally Sensitive Areas and Receptors	6	5	4	9
Renewable/Alternative Fuels Use	5	6	4	10
Environmental Related Spending	4	5	2	11
Climate Change Adaptation Efforts	2	3	2	13

Source: First Environment, Inc.

Corrective and Preventive Action

Fifteen of the 16 airports reported addressing corrective and preventive action in their EMS. Within the corrective and preventive action process:

- 14 address audit findings;
- 14 address environmental incidents;
- seven address employee suggestions;
- four address complaints from the public;
- two address drill results; and
- three airports independently identified that they address housekeeping issues such as labeling, storage, and cleanliness.
- Ten of the 15 airports report that they use a formal root cause analysis process as part of their corrective and preventive action process. (For more information on using root cause methodologies, go to http://www.epa.gov/sectors/sectorinfo/sectorprofiles/shipbuilding/module_15.pdf.) Potential participants in the root cause process are provided in Figure 15.

Document and Record Controls

All 16 airports have established or plan to establish and maintain records as necessary for their EMS.

Management Review

Top management at 15 of the 16 airports reviews the airports' EMS at planned intervals to ensure their effectiveness.

TOOLS

Eleven of the 12 airports with established EMS report using information technology tools to support their EMS.

Case Study: San Diego International Airport Uses GRI Reporting Guidelines

San Diego International Airport (SAN) prepares its annual sustainability report based on the GRI guidelines. GRI, an international non-profit organization, provides a comprehensive sustainability reporting framework that enables all organizations to measure and report their economic, environmental, social, and governance performance. The guidelines can be found at https://www.globalreporting.org/resourcelibrary/G3-Guidelines-Incl-Technical-Protocol.pdf.

SAN's report addresses the economic, environmental, and social criteria that the GRI guidelines suggest, as well as certain specific criteria from the GRI airport operators supplement. The SAN report includes metrics that track economical, environmental, and social performance. SAN's environmental performance reporting specifically addresses:

- waste reduction and recycling;
- water conservation;
- energy conservation;
- air quality;
- endangered species protection;
- sustainable building methods;
- noise issues; and
- employee awareness.

The report demonstrates SAN's commitment to managing sustainability within its EMS. It is available on the SAN's website and has social media buttons, making it easy to share. (http://sustain.san.org/wp-content/uploads/2012/05/Airport-Sustainability-Report_FINAL.pdf).

Root cause is a methodology used to identify underlying causes of an incident, event, or undesired outcome that aims to find the proper corrective and preventive actions to remove those causes and ultimately prevent both a reoccurrence of the incident and its potential occurrence in other parts of the organization. For more information on using root cause methodologies: (http://www.epa.gov/sectors/sectorinfo/sectorprofiles/shipbuilding/module_15.pdf).

This includes the EMS database, shared drive, maintenance scheduling and tracking system, intranet or internet website, geographic information system, noise monitoring software, and flight tracking software. The tools used are as illustrated in Table 4.

Access to the tools by type of tool is illustrated in Figure 16. Greatest access was provided to the environmental group with operations and maintenance close behind.

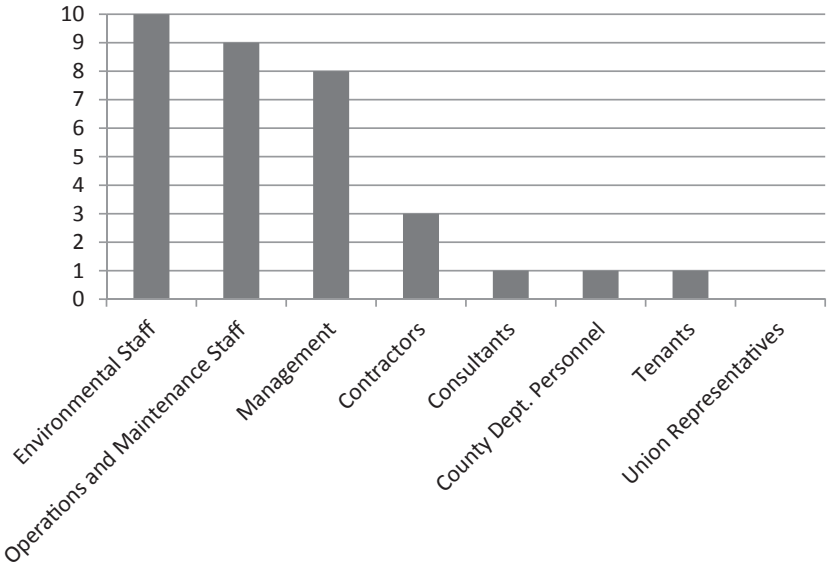

FIGURE 15 Participants in root cause analysis.

TABLE 4
TOOLS IN USE

EMS Tools	Use	Do Not Use
EMS Database	11	1
Shared Drive	11	1
Maintenance Scheduling and Tracking System	10	2
Intranet or Internet Website	10	2
Geographic Information System	9	3
Noise Monitoring Software	8	4
Flight Tracking Software	7	5

Source: First Environment, Inc.

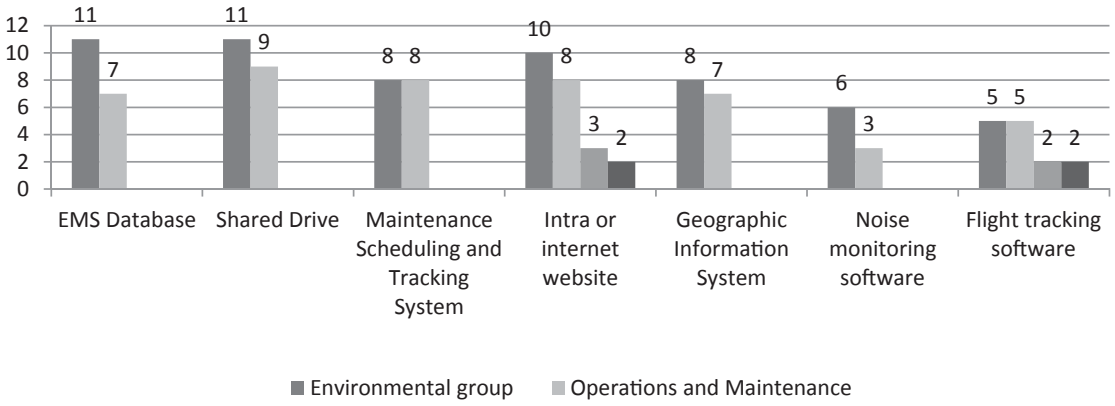

FIGURE 16 Access to tools.

CHAPTER SIX

LESSONS LEARNED

The survey queried the 12 airports that have developed and implemented EMS about lessons learned concerning:

- EMS responsibilities and support,
- EMS benefits,
- barriers in EMS implementation,
- greatest successes,
- what airports would do differently, and
- future plans.

ENVIRONMENTAL MANAGEMENT SYSTEM RESPONSIBILITIES

The majority (eight) of the 12 airports that have implemented EMS characterize the current status of their programs as being mostly the responsibility of the environmental personnel, although only four of these report that most EMS activities and responsibilities are assigned to the environmental department.

Four airports report that broad responsibility for their EMS is spread across environmental, maintenance, and operations. The two airports that did not have the environmental staff lead the development and implementation of the EMS identify themselves within this latter group.

MANAGEMENT SUPPORT

The 12 airports that have implemented EMS were asked to characterize their current view of management support (see Figure 17). Three reported that management support is fully supportive and resources are easily available; two of these are ISO 14001 certified airports.

Seven of the 12 airports characterized management as somewhat involved and reported competition for resources. Two of the airports characterize management as indifferent and resources difficult to obtain. As the EMS average age is 7.5 years, it is not clear based on this survey whether management was fully supportive and resources easily available at the time of implementation of the EMS. Interestingly, the degree of management support did not correlate with the number of significant benefits credited to the EMS (see Figure 18).

ENVIRONMENTAL MANAGEMENT SYSTEM BENEFITS

The airports with EMS were asked to rate various benefits they have obtained from their EMS. Seven reported that they had obtained all of the potential benefits about which they were asked. They reported either moderate or significant gain, as shown in Figure 18.

Airports ranked improved environmental performance highest, with all airports reporting moderate or significant improvements. Similarly, all airports reported experiencing improved integration of environmental responsibilities into line operations. With the exception of one airport in each category, there was moderate or significant benefit from improved employee understanding of environmental issues (including sustainability) and responsibilities, improved efficiency, improved compliance and regulator relationships, improved internal processes, greater management confidence, recognition of leadership within the industry, cost reduction, and environmental risk reduction.

Two airports reported no improved relationship with the public and other stakeholders. Five airports did not see an improvement in tenant relationships. Of those five airports, four had rated improved tenant relationships as at least somewhat important as a driver for developing an EMS. (It should be noted that the airports reporting no benefit were not the same airport in each case.)

The cost savings issue was interesting. Most airports did indicate that they had modest gains in this area, and two airports reported significant cost reductions.

BARRIERS TO IMPLEMENTATION

Airports were asked to identify barriers to implementing their EMS. The airports ranked a set of potential barriers (Figure 19) and responded to open-ended questions about the greatest barrier to effective implementation and solutions.

When asked to evaluate barriers to implementation they had encountered, a majority of the airports agreed that all of the barriers had some degree of relevance to their experience. All 12 airports that implemented EMS identified competing priorities as a barrier to implementation; all but two pointed

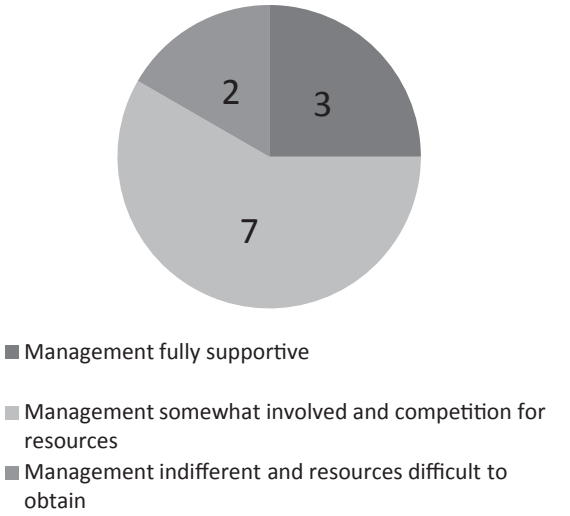

FIGURE 17 Management support.

to insufficient staff. Line management resistance was cited as a barrier by all but one of the airports. Limited awareness of the EMS and lack of top management support were of comparable relevance, based on their weighted rankings. Union or staff resistance was the least relevant; five of the 12 airports indicated that this was not at all relevant in their experience.

The survey requested that each airport identify its greatest barriers to effective implementation and if they were overcome, how. In all but four cases, the airports identified barriers without providing a solution, indicating the barrier may be an ongoing issue. The greatest barriers included communication between all lines of the business, lack of management support and staff indifference, inadequate resources, initial resistance, inconsistent use of the EMS among departments, and a problem of integrating the EMS into a new software structure.

One airport reported overcoming inconsistent initial support from involved county departments and contractors with persistence and increasing evidence over time of the value of the EMS. Similarly, a second airport reported initial resistance to change from the rank and file, which was overcome once they understood the benefits to the work environment. Employees then became "the main driving force (the EMS champions)."

One airport identified communication with staff and business partners as a barrier, and reported overcoming this by performing regular visits and audits and providing compliance assistance which contributed to relationship-building. Another reported a barrier associated with inadequate resources and

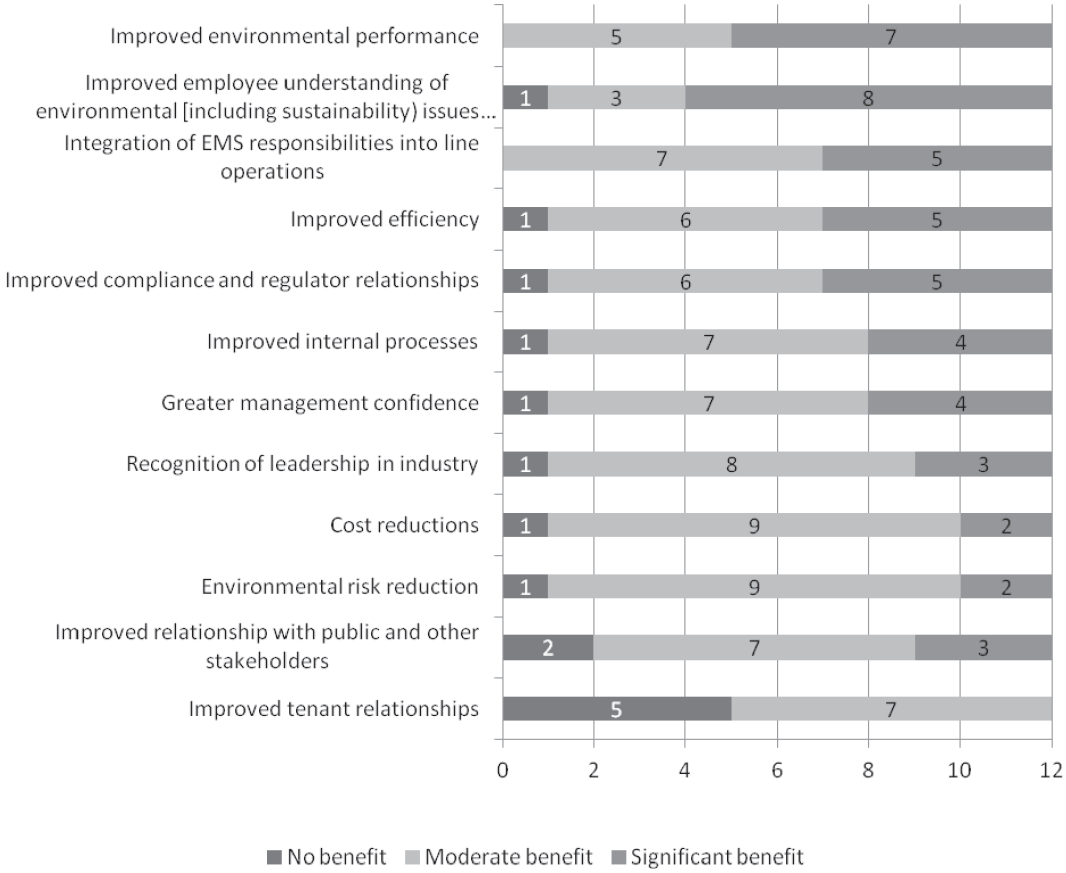

FIGURE 18 Benefits of EMS.

Case Study: Portland International Airport Cost Savings

The Port of Portland initiated its environmental management system in 2000, with the approval of its environmental policy by the Port Commission. The Port strives for an ISO 14001-conforming EMS implemented across port-wide operations including Portland International Airport (PDX), although formal certification to the standard has not yet been pursued. The following are a few examples of cost savings achieved through the Port's environmental programs, established to support implementation of its EMS:

Energy Management Program. The objectives of the Port's energy management program are a reduction in energy consumption and the purchase of renewable energy. For several years the Port has set a goal to reduce organization-wide energy consumption by at least 500,000 kilowatt hours each year. In FY2010-11, the Port targeted and completed lighting retrofit projects resulting in a savings of 401,200 kilowatt hours annually as well as a financial savings of about $20,000. To achieve the additional almost 100,000 kilowatt hour reduction for the year, the Port focused on incorporating energy-saving technology into the design and construction of the airport's new inline baggage screening system. The project used premium energy-efficient electric motors and qualified for funding from the Energy Trust of Oregon rebate program.

Waste Minimization Program. The objective of the Port's waste minimization program is to reduce waste generation and hazardous materials use. Over the years the program has been successful in reducing the amount of waste sent to landfills and improving recycling rates. In FY2011-12, the Port estimates that recycling activities at PDX resulted in a cost savings of $94,000, a combination of reduced hauls to the landfill and tip fees as well as recycling rebates.

Water Resources Program. The Port's water resources program aims to minimize impacts on water resources. In FY2011-12, the Port set an environmental target to involve PDX rental car companies in improving infrastructure and establishing a maintenance program for the rental companies' car wash facility, one of the Port's largest water users. The Port partnered with the rental car companies to implement water conservation measures that would achieve a minimum 20% reduction in water use per vehicle. The Port sought conservation recommendations for infrastructure and maintenance program improvements from the rental car agencies and included these in its new contracts. The program will result in an estimated cost savings of $145,000 from reduced water use and sewage bills for the rental car consortium over the term of the five-year contract. The Port will monitor the performance of these improvements to verify their effectiveness.

For a summary of Port of Portland's environmental performance results for FY2011-12, objectives and targets for FY2012-13, and highlights on environmental programs and projects, please visit www.portofportland.com.

In addition, the Port's recent move of its headquarters to a LEED™ Platinum office space above the long-term parking garage at PDX offered an opportunity to set a two-year target to become a zero-waste workplace. During the first year of the effort, outreach signage and a durable cup awareness and promotion campaign contributed to an increase in the landfill diversion rate from 76% to 82%. Now, in the second year of the effort, the Port continues to work towards its goal to become a zero waste office building, which requires a 90% or greater rate of waste diversion from landfills.

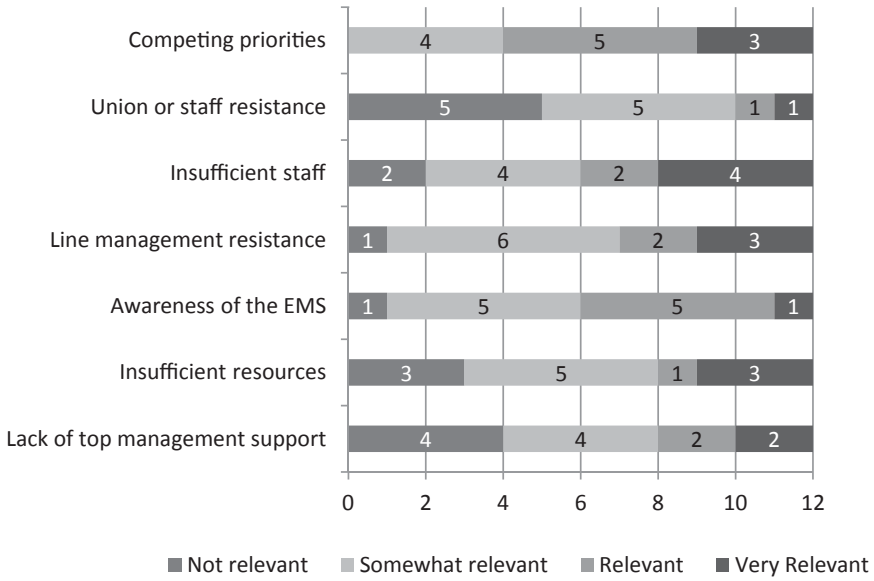

FIGURE 19 Barriers to implementation.

competing priorities by assigning a dedicated point person to manage the overall program.

SUCCESSES

The airports were asked the open-ended question, "What has been your greatest success?" Some of the responses refer to the successful completion of the project itself. Responses included:

- design and installation of the EMS;
- successful recertification of ISO 14001 (two airports); and
- survival of the EMS, the institutionalization of the EMS within all involved county departments, the resulting improved environmental performance, improved credibility with regulators, environmental organizations, and the concerned public.

Many referred to the integration of the system into the organization. Responses included:

- Rank and file employees' awareness of environmental impacts;
- The ability to turn around the rank and file and the perceptions concerning the EMS, as well as the integration of the EMS through the intranet;
- Using the "EMS Working Group" to improve awareness of issues and identify risks to help prioritize actions;
- Distributing environmental responsibilities throughout the organization and adopting other management systems throughout the airport;
- Organized response to emergency situations; and
- Environmental awareness programs, public outreach efforts, and pollution prevention initiatives.

One airport cited its recognition for environmental leadership and one pointed to its email alerts when tasks are coming due.

IMPROVEMENTS

The 12 airports were asked the open-ended question, "What would you do differently?" Four airports responded that they would not do anything differently. One airport indicated that it would scale back the EM or not implement it. Other airports responded:

- Provide a more accessible/flexible database system, better integrated with GIS mapping.
- Build more shared responsibility (beyond environmental staff) into the system.
- Have a better understanding of the requirements for the ISO 14001 EMS responsibilities.
- Have a dedicated point person/program manager.
- Make [the EMS] more of a priority and infuse it into the culture of the airport by getting departments more involved.
- Update the different parts of the EMS for the ones used and to make more sense of the information that they are inputting.

FUTURE PLANS

The final question of the survey asked, "How do you hope to improve your EMS over the next five years?" The airports responded:

- Beyond compliance, push sustainability concepts (build sustainability into the way of doing business).
- Bring more people into the process and make it more a part of regular operations.
- Continually improve key components of the EMS.
- Continue to add additional facilities.
- Include tenants and contractors with the airport's EMS and its processes.
- Make it user-friendly.
- Have more staff use it.
- As part of the airport's ISO certification, require the pursuit of continual improvement in operations.
- Keep it going; keep it relevant.
- Provide more resources and management involvement.
- Incorporate software into the program to provide database to track management of various airport projects and environmental aspects. System shall also provide database to track goals, environmental assessments, and training.
- Have better integration of environmental data into management decisions to enhance performance further and save money, and improved competency and awareness training.

CHAPTER SEVEN

CONCLUSIONS AND KNOWLEDGE GAPS

Most of the airports studied found that an Environmental Management System (EMS) is an effective and useful way to improve environmental performance and increase operating efficiency. These findings support the underlying assumption of management systems: that a system built with the proper structure, resources, and processes will result in improved performance.

From the results of the study, it can be concluded that the ISO 14001 Standard is the dominant framework used by the surveyed airports to develop an EMS. However, the selection of ISO 14001 does not mean that third-party verification and certification is being pursued. Those choosing not to certify cite the cost and time involved. Those who are certified perceive value in terms of independent confirmation of their EMS and credibility. Interestingly, even the airports that report not using the standard as the basis for their EMS address a great deal of the content of ISO 14001.

According to the results of the survey, the airports found that their EMS delivered on its promises; they achieved the benefits that had initially motivated them to implement an EMS. For example, improved environmental performance and improved employee understanding of environmental issues and responsibilities were the highest ranked reasons for developing an EMS by the airports (see chapter two, "EMS Drivers").

All airports with implemented EMS identified improved environmental performance as a benefit they had received; they had also identified it as a very important driver for developing the EMS. Similarly, improved employee understanding of environmental issues (such as sustainability) and responsibilities was reported by almost all of the airports with EMS in place; two-thirds of the airports that ranked improved understanding as important or very important drivers found that there was a corresponding significant or moderate benefit achieved in this area. Only one airport that ranked this as important concluded it had achieved no corresponding benefit.

This study establishes that an EMS provides a platform that will support an airport's environmental ambitions, whether it be a desire to ensure compliance, reduce risk, or systematically address sustainability. A majority of the airports has expanded the EMS beyond compliance to address sustainability challenges, which is demonstrated by what is managed in their systems. The airports that have a primary focus on compliance included typical concerns such as stormwater, spill avoidance, and air emissions. At least half of the airports also address sustainability issues such as greenhouse gas emissions, green building, and green purchasing, which indicates a broader approach than compliance. Furthermore, eight airports found that a significant benefit of having an EMS was an improved understanding of all environmental issues including sustainability.

Related to this, it is clear that EMS can initially be developed for a particular operation, such as a fuel farm, and then be expanded to tenant operations, for example. This indicates that EMS can be scaled to meet any individual airport's requirements. It also demonstrates that the goals for the system can become more ambitious over time, which many of the airports in the study report they plan to do in the next five years.

In general, airport EMS efforts were led by the environmental staff, although this is not the universal model. One effort was led by operations, and most of the airports included airport operations in their EMS with varying degrees of success. However, the involvement of tenants, contractors, and other stakeholders varies. Some airports fully include them in the system and some have more limited or no involvement. Those who include tenants generally report improved relationships.

Although the inclusion of operations and maintenance personnel within the EMS did not necessarily relate to satisfaction with their systems, the use of a cross-functional team to implement the system clearly correlated with the benefits received, indicating that using a cross-functional team may be a critical first step in developing an EMS that is more fully integrated into airport operations and thus provides greater benefits.

Airports reported that their greatest barrier to success was competing resources, followed by insufficient staff and operations management resistance. When asked to discuss their greatest barrier, however, they focused on penetration into the organization. This was supported by their intent in the next five years to expand and improve the penetration of the EMS into the organization, whether this included staff or tenants and other stakeholders. Two of the airports provided insight into overcoming this barrier and achieving greater participation, saying that providing direct experience with the EMS and enough time to recognize the benefits appears to be critical in achieving the desired goal. Direct experience

with the EMS allowed personnel to experience the benefits directly. Again, the use of a cross-functional team was cited as a factor that allowed airports to demonstrate to operations the benefits of an EMS.

Further research related to this synthesis includes:

- Research leading to guidance on how to successfully structure, implement, and improve on an EMS.
- Research leading to guidance to assist airports in integrating sustainability into an EMS framework.
- Costs to develop, implement, and manage EMS at airports.

This study and associated case studies provide indications of what contributes to a successful EMS, and it was clear that most airports achieved their intentions; however, a minority did not. The study identified current airport EMS practices through the self-reported survey results. It did not clearly answer what best practices are for airports and how or if they make a difference in aligning outcomes with intent. For airports considering an EMS, the study does not provide a road map for structuring and implementing an EMS. For airports that already have an EMS, it does not provide a methodology to maximize and leverage their EMS. For example, why did some airports achieve improved tenant relationships and others who wanted it did not? Also, what is the most effective way for an airport to move from managing regulatory obligations to managing risks? Or how can safety management and emergency response be effectively integrated across the organization?

A related gap in the research was the inconsistency in the broad-based involvement by airport staff in developing the EMS and the staff responsible for maintaining it. The environmental departments worked with operations and maintenance staff and others, such as tenants, to develop the EMS; however, they report it is primarily the responsibility of the environmental staff to maintain the EMS. The study did not indicate whether this was intentional or not, but hints that environmental departments would like broader involvement can be seen in the answers they provided on barriers and plans for the future. There is no clear explanation, based on the survey results, of how to achieve better penetration, although the use of a cross-functional team appears to be involved.

Research leading to guidance on successfully structuring, implementing, and improving on an EMS, drawing on established best practices at airports and other leading organizations with EMS already in place, would answer these questions and benefit both airports planning to implement an EMS and those with ones already in place.

A number of airports reported using their EMS to manage sustainability. The sustainability issues were identified, but the methodology used to integrate sustainability into an EMS was not established. Sustainability is increasingly becoming of concern to airports and as indicated by the study, some airports have found that an EMS provides an appropriate framework through which these issues can be managed. Research on guidance to integrating sustainability into an existing EMS framework would demonstrate how airports, regardless of size, can do the same. Further research may include a guidebook to assist airports in integrating sustainability into an existing EMS framework for airports of all sizes.

The large differences in the costs reported to implement an EMS were unexpected, and establishing better estimates on costs is important information for the airline industry. Costs ranged from $60,000 for a single airport to $11 million for a citywide EMS, too wide a range to be meaningful. Some of the airports reported no costs and/or that the information was not available. Others reported consultant costs, registrar costs, and no internal staff costs. The staff hours ranged from 0 to 45,000 hours at large hub airports, again a range making it difficult to determine reasonable costs. Others reported high costs ($500,000) for software and hardware. There was no correlation found between the cost and size of the airport, and there was no correlation between cost and ISO 14001 certification. Upon review and discussion with the airports, it was determined that the airports had drastically different scopes and approaches toward implementation. Without further study, cost comparisons among the airports surveyed cannot be made. Two case studies have been provided to better illustrate the issue, but a fuller study of costs and approaches to scoping the system could provide more useful information.

GLOSSARY

Accreditation—the means by which an authoritative body validates the conformance of a certification body (CB, also known as a registrar) to the requirements of international criteria (http://www.anab.org/resources/glossary.aspx).

Accreditation body (AB)—an authoritative body that issues CBs the authority to issue certifications to organizations under an international criteria.

Certification—used to verify the conformance of an organization's management systems to a standard or other requirement. Also sometimes referred to as registration (http://www.anab.org/resources/glossary.aspx).

Certification body (CB)—a third-party company contracted to evaluate the conformance of an organization's management systems to the requirements of the appropriate standards and issue a certificate of conformance when warranted. Also known as a registrar (http://www.anab.org/resources/glossary.aspx).

Environmental aspect—characteristics of an organization's activities or products or services that can interact with the environment.

Environmental impact—any change, positive or negative, to the environment.

Environmental performance—measurable results of an organization's impacts on the environment.

Environmental risk—the chance that a negative impact to the environment will occur.

Executive Order—policy directives issued by the President of the United States which do not require legislative action.

Global Reporting Initiative (GRI)—a non-profit organization that works towards a sustainable global economy by providing sustainability reporting guidance (https://www.globalreporting.org/Pages/default.aspx).

ISO 14001 International Standard Environmental management systems—Requirements with guidance for use—an international standard that establishes requirements for environmental management systems.

Plan-Do-Check-Act (PDCA) cycle—a four-step model for implementing change. The ongoing repletion of the four steps leads to continual improvement.

Significant aspect—aspect that has a meaningful impact on the environment, whether positive or negative.

Sustainability—using resources and impacting the environment to fulfill social and economic needs in a way that allows their continued use now and in the future.

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This guide outlines the basic concepts of an environmental management system and how it can be applied to many DOT activities, including suggestions on how to develop and implement an EMS at facilities.

Keywords: environmental management system, department of transportation, Center for Environmental Excellence, development, implementation

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This synthesis report targeted sustainability efforts and practices by airports from around the country and related those practices to other airport operators, stakeholders, and policymakers. It identifies a triple bottom line of environmental, economic, and social issues in reference to the overall sustainability practices.

Keywords: environmental management system, sustainability, reporting, triple bottom line, airports, stakeholders

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Keywords: ISO 14001, compliance, integration, environmental performance

Chicago Department of Aviation 2011 Sustainability Report, 2011 [Online]. Available: http://ohare.com/PDF/Environment/2011sustainreport.pdf.

This report is an evaluation and provides recommendations for O'Hare and Midway International Airports for potential applicability of sustainable initiatives. The Chicago Department of Aviation has made a concerted effort to embrace environmental, social, and economically responsible standards and practices at their airports.

Keywords: O'Hare International Airport, Midway International Airport, Chicago Department of Aviation, Sustainable Evaluation and Recommendation Team (SERT), planning, operations and maintenance, concessions, and tenants

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Keywords: Executive Order 13423, Executive Order 13123, Executive Order 13149, Energy Policy Act 2005, Energy Intensity, Renewable Energy, Federal Fleets

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Key words: environmental management system, European Commission

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Keywords: ISO 14001, environmental management systems, 3rd party audits, compliance, certification, environmental performance, due diligence, integration

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Keywords: ISO 14001, environmental management systems, time and cost structure, cost management, implementation, cultural factors, organizational factors, technological factors

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Keywords: Environmental Management Systems, Federal Aviation Administration, Plan-Do-Check-Act

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Keywords: Environmental Management Systems, Federal Aviation Administration, ISO 14001

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Keywords: Environmental Management System, FAA, scope, implementation and operation

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Keywords: Environmental Management System, ISO 14001, marketing opportunities, small to medium-sized enterprises, legal compliance, cost savings

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This is the second edition of the ISO 14001 standard that replaces that first edition that was published in 1996. This was developed by the Technical Committee ISO/TC 207. This ISO standard lays out the specific requirements of an environmental management system that can be objectively audited and sets up a process of continual enhancement in order to achieve environmental performance goals.

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Keywords: Environmental Management System, FAA, DOT, E.O. 13423

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Keywords: ISO 14001, costs, certifications, compliance process, implementation, accreditation

APPENDIX A

Surveys and Electronic Responses

ACRP Synthesis—Environmental Management System Development Process

TELEPHONE INTERVIEW—*all Respondents answered that they would participate in the electronic survey.*

We have been contracted by the Transportation Research Board—which is part of the National Academy of Sciences and funded by the U.S. government—to survey airports on their Environmental Management System practices. This is an important Airport Cooperative Research Program (ACRP) Synthesis survey that will provide information to you and other leaders in your critical industry.

Your name has been given to us as someone who is knowledgeable about your airport's environmental practices and has an interest in promoting progressive practices.

Would you mind answering a few questions for us? Your responses will be anonymous and aggregated for reporting purposes. The final report should be available next winter.

Is this a good time—when would be a good time to talk—if not now?

What time of day?

Assuming yes,

1. Are you the appropriate person to talk with about Environmental Management Systems at your airport?

   If no, who? And start with next person and whole intro
2. May we confirm spelling of name?
3. Title? (not included in report)
4. Best phone number? (not included in report)
5. E-mail address? (not included in report)
6. Has your airport ever considered or thought about developing an Environmental Management System? Y/N
7. If No, and they offer anything else, that could be considered an Environmental Management System for the purposes of this survey.
8. Would you be willing to respond to an electronic survey/questionnaire that is designed to take somewhere between 5 and 20 minutes depending on your system? Y/N
9. By the way, do you know anybody else who would be interested in answering these questions?

ACRP Synthesis—Environmental Management System Development Process

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ELECTRONIC SURVEY

Welcome to the Survey on Environmental Management System practices within the Airport Industry. The survey will take you between 5 and 30 minutes depending on your answers. All information you provide will be aggregated with the information from other airports. No airport-specific information will be disclosed from this survey. You may be asked to later participate in a case study. In that case only information you approve will be disclosed.

We recognize that the makeup of environmental management systems can vary and the survey is designed to accommodate these differences. Please fill out the survey based on the environmental management system your airport has developed, is in the process of developing, or has considered developing. Thank you.

1) What is your airport's current status?*

[4] Considering or thinking about an EMS

[1] Developing an EMS

[12] Have developed an EMS

[1] Considered or thought about and rejected implementing an EMS

[1] Tried to develop an EMS and failed

2) Rank the following issues as drivers for considering or thinking about an EMS at your airport.*

	Not Important	Somewhat Important	Important	Very Important
Improved environmental performance	[0]	[0]	[4]	[15]
Improved employee understanding of environmental issues and responsibilities	[0]	[1]	[7]	[11]
Environmental risk reduction	[0]	[1]	[8]	[10]
Compliance concerns	[0]	[3]	[5]	[11]
Improved internal processes	[0]	[3]	[7]	[9]
Leadership in industry	[0]	[3]	[8]	[7]
Airport management interest	[1]	[6]	[4]	[8]
Public or environmental organization interest	[0]	[8]	[6]	[5]
Cost reductions	[2]	[6]	[6]	[5]
Improved regulator relationships	[2]	[5]	[9]	[3]
Tenant or customer interest	[2]	[11]	[2]	[4]
Elected or appointed officials interest	[4]	[8]	[4]	[3]
Regulator requirement	[10]	[4]	[2]	[3]

Other—please list

[1] Management approved an environmental management system; while we have some goals, no developed system.

[1] Improved credibility with regulators, environmental organizational community, and concerned public

[1] Changed attitude and knowledge internally

If you did not develop an EMS

3) Rank the reason that influenced the decision not to develop an EMS.

	Not Important	Somewhat Important	Important	Very Important
Time requirements	[0]	[0]	[1]	[1]
Have sufficient programs in place	[0]	[1]	[0]	[1]
Amount of documentation and paperwork required	[0]	[0]	[2]	[0]
Manpower requirements	[0]	[0]	[2]	[0]
Potential cost	[0]	[2]	[0]	[0]
Lack of senior management support	[0]	[2]	[0]	[0]

4) Do you have any plans to reconsider this decision?*

[1] Yes

[1] No

End of survey for those who did not develop an EMS

If you are considering developing, in process of developing, or have developed, an EMS

Please answer the following questions based on what you have already developed or what you plan to develop for your EMS.

5) Does or will the EMS address the following environmental issues (check all that apply)?*

[16] Stormwater
[14] Air emissions
[13] Fuel and petroleum storage and use
[14] Chemical storage and use
[14] Solid waste management
[15] Hazardous or universal waste management
[15] Recycling
[8] Noise
[10] Water use and conservation
[10] Deicing
[7] Wetlands
[12] Energy use/efficiency
[9] Renewable energy
[7] Alternative and renewable fuels
[13] Clean/alternative fuel fleets, vehicles, or GSE
[16] Spill avoidance and response
[8] Endangered species
[8] Environmentally sensitive habitats and receptors
[6] Purchasing
[8] Green purchasing
[8] Green buildings
[10] Greenhouse gas emissions
[6] Climate change mitigation
[4] Adaptation to climate change
[8] Resource usage
[9] Sustainable design and development
[7] Land use planning
[3] Other

The following questions are about possible components of EMSs. Please identify the components that are included in your EMS.

6) Does or will your EMS include a policy?*

[15] Yes
[1] No

7) Does or will your EMS include the identification and evaluation of environmental impacts or risks?*

[13] Yes
[3] No

7a) If yes, is the evaluation of impacts or risks quantitative?*

[7] Yes
[6] No

7b) Will it or does it include environmental impacts or risks associated with Tenants and other operators at airport?

[7] Yes

[6] No

7c) Will it or does it include environmental impacts or risks associated with Contractors' operations?

[9] Yes

[4] No

7d) Are positive as well as negative impacts evaluated and assessed?*

[10] Yes

[3] No

8) Does or will your EMS include identification and implementation of legal requirements?*

[15] Yes

[1] No

8a) If yes, does or will it include compliance support for tenants and other operators?*

[12] Yes

[3] No

8a.1) If yes, do you provide regulatory training for tenants and other operators?*

[9] Yes

[3] No

8a.2) Do you provide tools or procedures to assess or implement compliance requirements?*

[9] Yes

[3] No

9) Does or will your EMS include compliance support for contractors?*

[10] Yes

[6] No

9a) If yes, do you provide regulatory training for contractors?*

[6] Yes

[4] No

9b) Do you provide tools or procedures to assess or implement compliance requirements?*

[9] Yes

[1] No

10) Does or will your EMS include setting of goals and development of programs to improve environmental impacts, reduce environmental risks or comply with legal requirements?*

[15] Yes

[1] No

10a) If yes, on what frequency are or will goals be set?*

[11] Annually

[2] Quarterly

[2] Biannually

10b) Is or will environmental goal setting be part of the planning and budgeting process for the airport?*

[12] Yes

[13] No

10c) Do or will you set measurable environmental performance goals?*

[15] Yes

[0] No

10d) How will you quantify?*

[1] Benchmark, best practices

[1] GHG emissions inventories, annual recycling/disposal tonnages, gallons of spillage, BMP compliance inspections/audits, etc.

[1] With monitoring and measurements

[1] Based on the goal, some numbers are per passenger

[1] Using numeric metrics

[1] Number of projects implemented

[1] Metrics will depend on the goals

[1] Number of recordable fuel spills, quantity of fuel that reaches storm drain, reductions in criteria air pollutants, monetary savings, etc.

10e) Metrics used?*

[1] Not yet determined

[1] Not defined yet, compliance, spill count/volume are ideas

[1] GHG emissions inventories (Metric tons CO_2 equivalents, annual recycling/disposal tonnages, gallons of spillage, BMP compliance inspections/audits, etc.)

[1] From records, what the requirements are, and what goals have been set

[1] Several metrics are used/tracked

[1] kWh, gallon, ton, $/passenger, etc.

[1] Number of project completed

[1] Metrics will depend on the goals

[1] Annual incidents

10f) Do your goals include the ACI NA Environmental Goals?*

[5] Yes

[10] No

10g) Do or will operations and/or maintenance personnel have defined responsibilities in achieving goals?*

[14] Yes

[1] No

10h) Are or will tenants and other operators be included in goal setting?*

[5] Yes

[10] No

11) Does or will your EMS include defined EMS roles and responsibilities?*

[16] Yes

[0] No

11a) Are or will most EMS responsibilities on the airport (airside and landside) be assigned to (check best fit)?*

[4] Environmental staff

[1] Airports operations and/or maintenance staff

[10] Split between environment and operations and maintenance staff

[1] Other: Assigned to responsible staff in the Environmental and Maintenance/Operations Groups

12) Do tenants and other operators have designated contacts with a defined role in the EMS?*

[5] Yes

[11] No

13) Is there an EMS internal advisory or implementation group that crosses airport functions?*

[13] Yes

[3] No

14) Is there an EMS advisory group or committee that includes external stakeholders?*

[0] Yes

[16] No

15) Does or will your EMS include training, EMS awareness and/or competency requirements?*

[16] Yes

[0] No

15a) Are EMS responsibilities included in job descriptions?*

[5] Yes

[11] No

15b) Check who receives or will receive environmental compliance training:*

[15] Environmental staff

[15] Operations staff

[15] Maintenance staff

[10] Emergency response staff

[9] Tenants and other operators

[7] Contractors

15c) Check all personnel who receive or will receive EMS awareness training:*

[16] Environmental staff

[14] Operations staff

[14] Maintenance staff

[9] Administration and financial staff

[11] Emergency response staff

[10] Management

[8] Tenants and other operators

[5] Contractors

16) Does or will your EMS include internal communication?*

(16) Yes

(0) No

16a) Do or will you have an intra or internet site to provide access to EMS information?*

(13) Yes

(3) No

16b) Do or will you report environmental performance information to (check all that apply)?*

[15] Management

[15] Environmental staff

[11] Operations staff

[12] Maintenance staff

[10] Administration and financial staff

[5] Tenants

[6] Other: GRI reporting, business partners, everyone that looks at our Internet website, public/stakeholders, board of directors, construction consultants/contractors

17) Does or will your EMS include external communication with stakeholders and/or regulators?*

[11] Yes

[5] No

17a) Does your communication include (check all that apply)?*

[7] A public report of environmental performance

[3] A public sustainability report

[3] Public meetings that report on environmental performance

[1] Public meetings that report on sustainability

[4] Meetings with tenants and other operators to report on environmental performance

[11] An intranet site

18) Does or will your EMS include environmental work procedures or instructions?*

[12] Yes

[4] No

19) Does or will your EMS include environmental related emergency planning and response?*

[12] Yes

[4] No

19a) Is environmental related emergency planning and response the responsibility of?*

[2] Emergency response staff

[1] Environmental staff

[9] Both

19b) Are environmental personnel included in Part 139 fire drills?*

[3] Yes

[9] No

20) Does or will your EMS include monitoring and measuring of progress of the EMS (check all that you monitor)?*

[15] Progress on goals

[13] Training

[13] Noncompliances

[3] Other: Corrective actions; nonconformance, preventative and corrective actions; voluntary monitoring of groundwater impacts

21) Does or will your EMS include monitoring and measurement of environmental performance indicators (check all that apply)?*

	Collect Data	Report Internally	Report Externally	Not Included	No. of Responses
Stormwater quality/quantity	[14]	[13]	[13]	[0]	16
Wastewater discharges	[12]	[10]	[9]	[3]	16
Noise levels	[9]	[9]	[8]	[7]	16
Noise mitigation efforts	[8]	[8]	[7]	[8]	16
Spills	[14]	[14]	[10]	[0]	16
Air emission	[12]	[12]	[11]	[3]	16
Greenhouse gas emissions	[10]	[9]	[8]	[4]	16
Greenhouse gas reductions	[9]	[10]	[8]	[5]	16
Climate change adaptation efforts	[2]	[3]	[2]	[13]	16
Water usage	[12]	[10]	[5]	[3]	16
Water conservation	[9]	[9]	[4]	[6]	16
Energy consumption	[12]	[12]	[6]	[3]	16
Energy conservation	[11]	[11]	[8]	[4]	16
Renewable energy/Green energy production	[6]	[7]	[4]	[9]	16
Solid waste	[13]	[12]	[10]	[2]	16
Recycling	[13]	[14]	[10]	[1]	16
Noise complaints	[8]	[9]	[6]	[7]	16
Petroleum use	[8]	[9]	[7]	[7]	16
Renewable/alternative fuels use	[5]	[6]	[4]	[10]	16
Chemical use	[10]	[10]	[7]	[4]	16
Deicing chemicals use	[10]	[11]	[7]	[4]	16
Hazardous and universal waste	[13]	[10]	[9]	[2]	16
Endangered species	[8]	[7]	[7]	[8]	16
Environmentally sensitive areas and receptors	[6]	[5]	[4]	[9]	16
Habitat restoration	[4]	[6]	[6]	[9]	16
Green purchasing	[7]	[7]	[4]	[8]	16
Green buildings	[8]	[8]	[5]	[8]	16
Environmental related spending	[4]	[5]	[2]	[11]	16
Fines associated with environmental noncompliance	[6]	[5]	[4]	[9]	16

21b) Other environmental performance indicators?

Site restorations, air quality conformity, clean air vehicle conversions, groundwater quality

21c) Is or will performance data be normalized (check the appropriate box)?*

[4] None

[11] Some

[1] All

22) Does or will your EMS include audits?*

[15] Yes

[1] No

22a) If yes, do you perform management system audits?*

[11] Yes

[4] No

22a.1) On what frequency do you perform management system audits?*

[1] Biannually

[5] Annually

[3] Every 3 years

[1] When recommended

[1] On set schedule

22b) Do you perform compliance audits of airport operations?*

[12] Yes

[3] No

22b.1) On what frequency do you perform compliance audits of airport operations?*

[1] Biannually

[2] Semi-annually

[5] Annually

[3] Every 3 years

[1] Quarterly

22c) Are tenants and other operators required to perform compliance audits?*

[6] Yes

[9] No

22d) Do you perform compliance audits on tenants?*

[8] Yes

[7] No

22d.1) On what frequency do you perform compliance audits on tenants?*

[5] Annually

[3] Between 1 and 3 years

[1] Every 3 years for those without an EMS

[1] Varies by type of tenant operation

23) Are audit findings evaluated for trends?*

[11] Yes

[4] No

24) Does or will your EMS include a corrective and preventive action process?*

[15] Yes

[1] No

24a) What is addressed through the process (check if included)?*

[14] Audit findings

[14] Environmental incidents

[2] Drill results

[7] Employee suggestions

[4] Complaints from the public

[3] Other: Hazmat, storage, cleanliness, root cause analyses

24b) Are causes of nonconformances ever addressed through formal root cause analysis?*

[10] Yes

[5] No

24b.1) Who may be included in the root cause analysis (check all that apply)?*

[10] Environmental staff

[8] Management

[9] Operations and maintenance staff

[0] Union representatives

[3] Contractors

[3] Other: Tenants for stormwater or releases, consultants, county department personnel

25) Does or will your EMS include recordkeeping and document control requirements?*

[16] Yes

[0] No

26) Does or will your EMS include management review of progress of the EMS?*

[15] Yes

[1] No

27) What resources did you use or will you use to develop your EMS (check all that apply)?*

[15] Internal environmental staff

[13] Operations and/or maintenance staff

[10] Cross functional development team

[3] Tenant representatives

[3] Stakeholder representatives

[11] External consultants

[3] External EMS templates or software

[5] External training

[2] Other: Employees EMS Awareness Training; environmental consulting department

28) Is or will your airport's EMS be based on the plan-do-check-adjust model?*

[15] Yes

[1] No

29) Do or will you use the ISO 14001 Environmental Management System Standard requirements to develop your system?*

[12] Yes

[4] No

29a) If not, do or will you use another standard?*

[0] Yes

[4] No

30) What is or will be the primary purpose of your EMS (select one)?*

[5] Compliance

[11] Beyond compliance

31) Are you or will you be third party certified to ISO 14001?*

[6] Yes

[10] No

31a) If no, please rank the reasons for not seeking certification.*

	Not Important	Somewhat Important	Important	Very Important
Cost	[0]	[1]	[5]	[4]
Time required	[0]	[3]	[5]	[2]
No value in being certified	[1]	[6]	[2]	[1]
No need for independent review	[3]	[5]	[1]	[1]

31b) If yes, please rank the benefits of certification.*

	Not important	Somewhat important	Important	Very important
Independent confirmation of EMS effectiveness	[0]	[0]	[2]	[4]
Credibility	[0]	[0]	[2]	[4]
Better rate of performance improvement	[0]	[0]	[4]	[2]
Better employee buy-in	[0]	[1]	[3]	[2]

32) How long has your EMS been in place?*

[1] 15 years

[4] 10 years

[2] 8 years

[1] 7 years

[1] 5 years

[2] 4 years

[1] 2 years

33) How long did it take you to develop your EMS?*

[1] less than one year

[1] 1 year

[5] 2 years

[3] 3 years

[1] 4 years

[1] around 10 years

34) What was the cost of implementation?*

	Type answer
Internal labor costs	[6] Unknown [1] $10,000 [1] $30,000 [1] $50,000–$100,000 annually to operate EMS [1] $60,000 [1] $80,000 [1] $1,000,000
Number of internal man hours	[7] Unknown [1] 300 [1] 3,000 [1] 45,000 [1] 20,000
External costs	[6] Unknown [3] $0 [1] $1,000 [1] $5,000 [1] $5,000,000
Consultant cost	[3] Unknown [1] $0 [1] $5,000 annually [2] $50,000 [1] $200,000 [1] $295,373 [1] $400,000 [1] $485,000 [1] 4,000,000
Hardware and software cost	[2] Unknown [8] $0 [1] $10,000 [1] $500,000
Other costs	[5] Not applicable [3] $0 [1] $5,000 training [1] $12,000 annual hosting [1] $500,000

35) How would you best characterize the current status of your EMS (check one)?*

[8] Mostly the responsibility of environmental personnel

[4] Broad responsibility across environmental, maintenance and operations

36) Which department(s) or division(s) was primarily responsible for developing your EMS?*

[9] Environmental (Environmental Affairs, Environmental Services, Office of Environmental Quality)

[1] Fueling Facilities and Civil Environmental Engineering Groups

[1] County Department of Transportation

[1] Department of Facilities (Environmental compliance and environmental planning)

37) How would you characterize management support (check answer that best fits)?*

[3] Management fully supportive and resources easily available

[7] Management somewhat involved and competition for resources

[2] Management indifferent and resources difficult to obtain

38) Of the following EMS tools, who is provided access (check all that apply)?*

	Don't have	Environmental group	Line operations	Tenants	Public
Intra or Internet website	[2]	[10]	[8]	[3]	[2]
EMS database	[1]	[11]	[7]	[0]	[0]
Shared drive	[1]	[11]	[9]	[0]	[0]
Maintenance scheduling and tracking system	[2]	[8]	[8]	[0]	[0]
Geographic information system	[3]	[8]	[7]	[0]	[0]
Flight tracking software	[5]	[5]	[5]	[2]	[2]
Noise monitoring software	[4]	[6]	[3]	[0]	[0]

39) Please rank the benefits your airport has received from your EMS:*

	No benefit	Moderate benefit	Significant benefit
Improved compliance and regulator relationships	[1]	[6]	[5]
Improved relationship with public and other stakeholders	[2]	[7]	[3]
Improved efficiency	[1]	[6]	[5]
Integration of EMS responsibilities into line operations	[0]	[7]	[5]
Greater management confidence	[1]	[7]	[4]
Improved tenant relationships	[5]	[7]	[0]
Environmental risk reduction	[1]	[9]	[2]
Cost reductions	[1]	[9]	[2]
Improved environmental performance	[0]	[5]	[7]
Improved internal processes	[1]	[7]	[4]
Improved employee understanding of environmental [including sustainability) issues and responsibilities	[1]	[3]	[8]
Recognition of leadership in industry	[1]	[8]	[3]

40) Characterize the following barriers to implementation as to their relevancy to your experience:*

	Not relevant	Somewhat relevant	Relevant	Very Relevant
Competing priorities	[0]	[4]	[5]	[3]
Insufficient staff	[2]	[4]	[2]	[4]
Line management resistance	[1]	[6]	[2]	[3]
Awareness of the EMS	[1]	[5]	[5]	[1]
Insufficient resources	[3]	[5]	[1]	[3]
Lack of top management support	[4]	[4]	[2]	[2]
Union or staff resistance	[5]	[5]	[1]	[1]

41) What has been your greatest barrier to effective implementation? Did you overcome it, and if so, how?*

[1] Communication between all lines of business.

[1] Lack of management support, it remains a major problem for EMS implementation.

[1] Lack of support and participation from maintenance. Limited resources.

[1] Other staff indifference

[1] Senior management indifference

[1] Adequate resources/competing priorities and a dedicated point person. Added dedicated point person to manage the overall program.

[1] Lack of environmental staff to use the system, as well as no other division staff using the system although trained 5 years ago (each division seems to have their own type of EMS)

[1] The amount of labor to set up and maintain the EMS and the lack of interest. Basically, only the environmental staff uses the system.

[1] Inconsistent support initially from all involved county departments and contractors. It was overcome by persistence and increasing evidence over time of the value of the EMS.

[1] Initial resistance to change from the rank and file. However, once they understood the advantages to their work environment of implementing an EMS, they became the main driving force (the EMS champions). Currently, one of our most significant barriers to implementing our environmental goals is the "red tape" of our governmental centralized procurement system.

[1] Communication with extended staff and other business partners. Regular visits, audits, and compliance assistance [i.e. relationship building)

[1] Presently revamping the EMS into new software structure. Barriers will include integrating new program with existing processes and gaining support from management and staff.

42) What has been your greatest success?*

[1] E-mail alerts when tasks are coming due.

[1] Environmental awareness programs, public outreach efforts, pollution prevention initiatives

[1] Having the EMS designed and installed was a great accomplishment

[1] Organized response to emergent situations

[1] Rank and file employees' awareness of environmental impacts

[1] Recognition for environmental leadership

[1] Successful recertification on numerous occasions

[1] Twice achieving ISO 14001 certification from an independent auditor

[1] Survival, the institutionalization of the EMS within all involved county departments, the resulting improved environmental performance and improved credibility of the airport with regulators, environmental organizations and the concerned public

[1] The ability to turn around the rank and file perceptions concerning the EMS. Currently, the integration of our EMS system through our intranet (Greenpoint)

[1] Working together on the "EMS Working Group" has improved awareness of issues and helps identify risks, which helps prioritize the actions

[1] Environmental responsibilities distributed throughout the organization. Adoption of other management systems throughout the airport

43) What would you do differently?*

[1] A more accessible/flexible data base system, better integrated with GIS mapping.

[1] Build more shared responsibility (beyond environmental staff) into system

[1] Have a better understanding of the requirements for the ISO 14001 EMS and the responsibilities

[1] Have dedicated point person/program manager

[4] Nothing

[1] Scale it back or not implement

[1] Hire different consultant for EMS implementation

[1] Make it more of a priority and infuse it into the culture of the airport by getting all departments more involved

[1] Would like to update the different parts of the EMS for the ones that we use and to make more sense on the information that we are inputting.

44) How do you hope to improve your EMS over the next 5 years?*

[1] Beyond compliance, push sustainability concepts (build sustainability into way of doing business)

[1] Bring more people into the process and make it more a part of regular operations

[1] Continual improvement of key components of the EMS

[1] Continue to add additional facilities

[1] Include tenants and contractors with the airport's EMS and its processes

[1] Making it user friendly

[1] More staff will use it

[1] Our ISO Certifications require the pursuit of continual improvement in our operations

[1] Keep it going, keep it relevant

[1] Need more resources and management involvement

[1] Incorporate software program to provide database to track management of various airport projects and environmental aspects. System shall also provide database to track goals, environmental assessments, and training.

[1] Better integration of environmental data into management decisions to enhance performance further and save money, and improved competence and awareness training.

APPENDIX B

Electronic Survey Respondents

Name of Airport	Airport Code	Airport Size	Location	First Name	Last Name	E-mail
Cleveland Hopkins International Airport	CLE	M	OH	Kim	McGreal	kmcgreal@clevelandairport.com
Dallas/Fort Worth International Airport	DFW	L	TX	Asciatu	Whiteside	awhiteside@dfwairport.com
Dallas Love Field	DAL	M	TX	Bill	Brewer	William.brewer@dallascityhall.com
Denver International Airport	DEN	L	CO	Jeffrey	Arneson	jeff.arneson@flydenver.com
Greater Toronto Airports Authority	YYZ	L	ON	Randy	McGill	randy.mcgill@gtaa.com
Indianapolis International Airport	IND	M	IN	Tim	Method	tmethod@ind.com
John Wayne Airport, Orange County	SNA	S	CA	Maria	Pope	mpope@ocair.com
LaGuardia Airport	LGA	L	NY	Arlyn	Purcell	apurcell@panynj.gov
Los Angeles International Airport	LAX	L	CA	Robert	Freeman	rfreeman@lawa.org
Massachusetts Port Authority	BOS	L	MA	Brenda	Enos	Benos@massport.com
Miami International Airport	MIA	L	FL	Arturo	Sosa	Asosa@miami-airport.com
Nashville International Airport	BNA	M	TN	Christine	Vitt	christine_vitt@nashintl.com
Philadelphia International Airport	PHL	L	PA	Mike	McCartney	mike.mccartney@phl.org
Phoenix Sky Harbor International	PHX	L	AZ	Cynthia	Parker	Cynthia.parker@phoenix.gob
Portland International Airport	PDX	M	OR	Shannon	Tocchini	Shannon.Tocchini@portofportland.com
San Diego International Airport	SAN	L	CA	Paul	Manasjan	pmanasja@san.org
San Francisco International Airport	SFO	L	CA	Houshang	Esmaili	houshang.esmaili@flysfo.com
Vancouver International Airport	YVR	L	BC	Simon	Robinson	simon_robinson@yvr.ca
Westchester County Airport	HPN	S	NY	Robert	Funicello	waa@westchesteraviation.org

Abbreviations used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation