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AIRPORTS GOING GREEN: HOW THE AIRPORTS ARE IMPLEMENTING
SUSTAINABILITY PRACTICES IN THE UNITED STATES

by

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B.S., Southern Illinois University, 2009

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Master of Public Administration.

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Master of Public Administration
in the field of Political Science

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GLOSSARY

ACRP	Airport Cooperative Research Program
CC	Continuous Commissioning
EONS	Economic viability, Operational efficiency, Natural resource conversation, and Social responsibility
EMS	Environmental Management System
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
GARB	General Airport Revenue Bond
Large Hub Airport	A commercial service airport with scheduled passenger service of over 10,000 enplaned passengers and has at least 1% of the national enplaned passengers.
LAWA	Los Angeles World Airports
LEED	Leadership in Energy and Environmental Design
Medium Hub Airport	A commercial service airport with scheduled passenger service of over 10,000 enplaned passengers and has between .25% to 1% of the national enplaned passengers.
OMP	O'Hare Modernization program
PFC	Passenger Facility Charge
SAGA	Sustainable Aviation Guidance Alliance
SAM	Sustainable Airport Manual
SDCRAA	San Diego County Regional Airport Authority
Small Hub Airport	A commercial service airport with scheduled passenger service of over 10,000 enplaned passengers and has between .05% to .25% of the national enplaned passengers.
Sustainability	As of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged.
TRB	Transportation Research Board
USGBC	U.S. Green Building Council
WaterSense	EPA partnership program that helps people save water with a product label and provides tips for saving water.

INTRODUCTION

The Environmental Protection Agency (EPA) describes sustainability as being based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment (EPA, 2012).

Sustainability allows humans and nature to coexist in productive harmony, preserving the social, economic and other requirements of present and future generations (EPA, 2012). The U.S. Green Building Council (USGBC) developed the Leadership in Energy and Environmental Design (LEED) which provides building owners and operations a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions (USGBC, 2009). LEED is internationally-recognized by architects and builders for its green building certification system that uses strategies to improve performance in the areas that are most important including: energy savings, water efficiency, Carbon Dioxide emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts (USGBC, 2009). LEED is a voluntary certification program that promotes a whole-building approach to sustainability by recognizing performance in areas such as water efficiency, sustainable building sites, reducing energy used by buildings, recyclable materials and resources used, and finally the quality of the environment indoors (USGBC, 2009). LEED provides standards to reduce carbon footprint, increase energy savings, encourages innovation, and promotes corporate responsibility. The FAA (2010) defines Airport sustainability, "...as a broad term that encompasses a wide variety of practice applicable to planning, design, building and operating airport facilities with three core principles: Protecting the Environment,

maintaining high and stable levels of economic growth, and social progress that recognizes all stakeholders' needs" (p. 1). Through a literature review this paper will answer the question, "How are large hub airports implementing sustainability practices and which sustainability practices used at large hub airports could apply to medium and small hub airports?"

The terms "Green" and "sustainability" are often used interchangeably, however, although related they are slightly different. According to Merriam-Webster Online dictionary (2013), the term "Green" relates to tending to preserve environmental quality such as by recycling, using biodegradable materials, or nonpolluting. Merriam-Webster Online dictionary (2013) defines "sustainable" as of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged. Something can be both Green and sustainable if it fits both definitions.

The terms "Environmental Assessment" (EA) or "Environmental Impact Statements" (EIS) may easily be confused with Environmental Management Systems (EMS) and a Sustainable Master Plan. The key differences are EA's and EIS' are project specific on how the environment will be impacted while a Sustainability Master Plan is a holistic approach to long-term planning which included the environment, economic, and social impacts. Finally, EMS is a tool that is used to help manage and track data. EMS is a continuous improvement cycle of Commitment, Planning, Implementation, Evaluation, and Review (EPA, 2012).

Airport operators across the country are beginning implementation of sustainability programs and initiatives at their airports. One reason for this are new federal and state directives that encourage airports to develop a sustainability program.

Airport sustainability has become one of the top priorities in the nation, primarily due to federal, state, and local initiatives. Airport sustainability can be defined as a holistic approach to managing an airport so as to ensure the integrity of the Economic viability, Operational efficiency, Natural resource conservation, and Social responsibility (EONS) of the airport (ACI-NA, 2007). The Federal Aviation Administration's (FAA) sustainable actions are: reduce environmental impacts; help maintain high, stable levels of economic growth; help achieve "social progress", a broad set of actions that ensure organizational goals are achieved in a way that's consistent with the needs and values of the local community (FAA, 2012, p. 1). Many airports are implementing sustainability programs because they believe it will help meet environmental, economic and social goals to benefit the community.

To better understand the implementation of sustainability at airports across the United States, airports such as Chicago O'Hare International Airport, San Diego International Airport, Los Angeles World Airports, DFW International Airport, Boston Logan Airport, Seattle-Tacoma International Airport, and Fresno Yosemite International Airport will be examined. The Sustainable Airport Manual (SAM) authored by the City of Chicago Department of Aviation will also be examined for the best sustainability practices in the field. DFW International Airport, Boston Logan Airport, Seattle-Tacoma International, and Fresno Yosemite International Airport were chosen because they participated in the FAA's Airport Sustainable Master Plan Pilot Program. Chicago O'Hare International Airport, San Diego International Airport, and Los Angeles World Airports (LAX and Ontario International) were chosen because of their leadership in the area of airport sustainability planning. I chose this mixture of 3 large hub airports and 1

small hub airport to compare those in the FAA's Airport Sustainable Master Plan Pilot Program. The other 3 large hub airports and 1 medium hub airport were not included in the pilot program and were chosen because of their documented sustainability practices. In addition, I will show the cost-related benefits to airports "going green" and the positive effects of sustainability in the community.

Drivers and Barriers for Sustainability

As sustainability becomes a bigger issue for the aviation industry, it is important to understand the motivation for airport operators to improve their environmental, social, and economic performance (ACRP, 2008). According to ACRP (2008), the survey questions related to sustainability drivers focused on the motivations behind the sustainability practices already implemented in airports and the drivers for future practices (p.9). "Of the 52 airports surveyed, 25 responses were received, representing a 48% response rate" (ACRP, 2008, p. 8).

Figure 1

Rank	Current	Future¹
1.	State/Regional Regulations	Stakeholder Concerns/Relations
2.	Local Airport Policy	Global Trends
3.	Federal Regulations	Local Airport Policy
4.	Corporate Responsibility	Corporate Responsibility
5.	Stakeholder Concerns/Relations	Federal Regulations

Source: ACRP, 2008

¹ Note: "future" was not given a specific timeframe in this survey.

The survey respondents consisted of 16 U.S. airports in the following categories: 9 large hub, 4 medium hub, 2 small hub, and 1 non-hub airports (ACRP, 2008, p. 8). Listed in Figure 1 are the top five results from the ACRP survey of airport operators for current and future drivers of airport sustainability (ACRP, 2008).

There is a shift from the current drivers as state and regional regulations to the future driver of stakeholder concerns and relations. This is because currently many airports are trying to meet the current regulations. Federal and state regulations are always adapting to the new technology and airports are always ensuring they are meeting current and new regulations. In the future stakeholder concerns and relations become the top driver because airport operators want the airport to operate as efficiently and environmentally friendly as possible because that is what stakeholder want. Some key priorities that airport operators identified in the ACRP (2008) survey were energy conservation, efficiency, reducing carbon dioxide emissions, clean energy production, clean fuel vehicles, and green build certification using LEED.

Airport operators need to be concerned with barriers to implementation of sustainability. The ACRP (2008) survey also sought to find barriers to slow or failed sustainability implementation. The top barrier was identified as lack of funding. A few other top barriers included limited staff knowledge of sustainability, lack of staffing, and lack of management support. It is important for the airport to secure proper funding to fully carry out the airport's sustainability program (ACRP, 2008). Funding sources can include: FAA's Airport Improvement Program, Passenger Facility Charges, and airport bonds.

FAA Sustainable Master Plan Pilot Program

In 2010, the FAA introduced the Sustainable Master Plan Pilot Program. “This program is evaluating ways to make sustainability a core objective at every airport by funding long-range planning documents at ten airports around the country. These documents, called Sustainable Master Plans and Sustainable Management Plans, included initiatives for reducing environmental impacts and achieving economic benefits while increasing integration with local communities” (NCTCOG, 2011, p. 7). The goal of the pilot program is to help airports achieve their planning and operational objectives while reducing environmental impacts, achieving environmental benefits, and improving relationships with local communities (FAA, 2012). The FAA’s (2012) plan is to pursue this goal through preparation of comprehensive, long-range plans that incorporate sustainability. Figure 2 shows the list of the ten airports participating in the FAA Sustainable Master Plan Pilot Program.

Figure 2

Airport	Plan Type
Denver International Airport	Sustainable Management Plan
Fresno Yosemite International Airport	Sustainable Management Plan
Hartsfield-Jackson Atlanta International Airport	Sustainable Management Plan
Ithaca-Tompkins Regional Airport	Sustainable Master Plan
Nashville International Airport	Sustainable Master Plan
Newark Liberty International Airport	Sustainable Management Plan
Newport News/Williamsburg International Airport	Sustainable Master Plan
Newton City-County Airport	Sustainable Master Plan
Northeast Florida Regional Airport	Sustainable Management Plan
Outagamie County Regional Airport	Sustainable Management Plan
Renton Municipal Airport	Sustainable Management Plan
Teterboro Airport	Sustainable Management Plan

Source: FAA, 2012

The Sustainable Master Plan Pilot Program's Interim Guidance allowed airports to choose between two sustainability plan types, Sustainable Master Plans and Sustainable Management Plans (FAA, 2012). Sustainable Master Plans incorporates integrating sustainability into the airport long-range planning while a Sustainable Management Plan is its own stand-alone document (FAA, 2012). The FAA (2012) found that balancing sustainability objective and aviation needs is challenging in a Sustainable Master Plan (p. 2). Some early deliverables of sustainable master plans tended to look like stand-alone management plans (FAA, 2012, p. 2). The pilot program also found that airports who chose to prepare a sustainable master plan were pleased with their decision because of the opportunities to align sustainability and planning (FAA, 2012). The FAA (2012) also found the airports that intersperse sustainability throughout the master plan were more effective than those that dedicate an entire chapter to sustainability (p. 2). The FAA (2012) learned that airports that have limited resources must focus on initiatives that achieve objectives with low implementation costs (p. 5). Examples of good projects for medium and small hub airports include: switching to compact fluorescent light bulbs or natural light to reduce energy costs; drought tolerant and slow growing grass to reduce irrigation and mowing costs; and installing low flow toilets and water fixtures. Several good sources for low-cost measures include: the Sustainable Aviation Guidance Alliance (SAGA) database and *ACRP Report 43: Guidebook of Practices for Improving Environmental Performance at Small Airports*. It is best for small airports to prioritize sustainability initiatives since their resources are far less than large airports.

IMPLEMENTATION

The CEO of DFW airport, Jeff Fegan (2012) said, “There’s the easy way to do something and then there’s the right way” (p. 1). Jeff is referring to the approach DFW is taking to development of the DFW airport. The easy way may be cheaper and faster, however, it may cost more pollution to the environment and cost more in the long haul compared to the “right way” or environmentally “Green” friendly way. The initial investment of using LEED-certified materials and processes may be more expensive but will pay off down the road as the operating expenses and energy costs are less than traditional methods. The following are examples of implementation of sustainable planning and green initiatives at airports across the United States.

O’Hare Modernization Program

“The O’Hare Modernization Program (OMP) is Mayor Richard M. Daley's vision for building a 21st century airport at O'Hare at no cost to local or state taxpayers” (City of Chicago, 2003). The funding for this project will come from the passenger facility charges (PFCs), General Airport Revenue Bonds (GARBs), and federal Airport Improvement Program Funds (Chicago Department of Aviation, 2010). A GARB is a bond issued to finance a specific revenue generating project and, unless backed by third-party guarantees, is usually secured solely by the revenues from the project (Quilty, 1999, p. 3).

Mayor Daley has made it clear that one of his top priorities was making the City of Chicago “go green”. One of his biggest projects is the OMP which is a leader in the airport sustainability initiative. “The OMP introduced the Sustainable Design Manual (SDM) in 2003, to ensure that sustainable initiatives and measurements were

implemented during the build out and modernization of Chicago O'Hare International Airport" (City of Chicago, 2012, p.3). The OMP is a project to transform O'Hare International Airport's airfield to a more modern and efficient parallel runway configuration. This parallel configuration will help to reduce delays and increase traffic and revenues for O'Hare. Also, the OMP will add an additional passenger terminal to the west end of the airport to ease congestion and better balance access for the airport users. In 2008, the OMP opened a 3,000-foot extension to O'Hare's busiest runway, Runway 10/28, a new runway and a new air traffic control tower. All three projects opened on or ahead of schedule, and nearly \$40 million under budget (Chicago Department of Aviation, 2010). When the OMP is complete in 2014, O'Hare will have a total of eight, 6 parallel and 2 crosswind, runways totaling an estimated \$6.6 billion (Chicago Department of Aviation, 2010).

Once the OMP is complete, O'Hare will add 195,000 more jobs and another \$18 billion in annual economic activity on top of its current 450,000 jobs and \$38 billion economic activity (Chicago Department of Aviation, 2010). The OMP will not only generate more money and jobs for the City of Chicago, but also save the airlines utilizing O'Hare an estimated \$370 million annually and the passengers \$380 million a year (Chicago Department of Aviation, 2010).

The SDM believes a design process is necessary to help the OMP keep on schedule and budget. To help attain this goal the SDM recommends that all members of the design team establish goals. The SDM used the LEED grading system to help develop their own higher system, the Chicago standard, for grading of airport sustainability. The City of Chicago was the first in the nation to develop sustainable

guidelines for design and construction at airports (City of Chicago, 2012). The vision statement for the SDM is: “O’Hare International Airport will continue to evolve as a benchmark for environmental stewardship in design and construction. The O’Hare Modernization Program will embrace the best possible environmental, social and fiscally responsible practices to enhance the quality of life and maintain consistency with the overall mission and goals of the City of Chicago” (City of Chicago, 2012, p. 8). The SDM is meant to supplement existing laws including: Federal Aviation Administration (FAA), U.S. Environmental Protection Agency, Illinois Environmental Protection Agency, U.S. Department of Agriculture, Illinois Department of Transportation standards, City of Chicago Department of Aviation Design and Construction Standards, and any other pertinent federal, state, and local laws and/or codes.

The SDM includes sections on recommended Sustainable Site Management, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, O’Hare Facility Operations, OMP Intertask Resource Coordination, and OMP Construction Practices. Although a few of these sections are specific to O’Hare International Airport, other airports may use them as guidelines to develop their own sustainable practices.

Sustainable Airport Manual

Chicago continued to expand the SDM into the Sustainable Airport Manual (SAM) for all aspects of airport planning including airport concessions and tenants. These manuals are constantly growing as they discover new and improved sustainability practices. “The purpose of the SAM is to integrate airport-specific sustainable planning and practices early in the design process through construction,

operations, maintenance and all airport functions with minimal impact to schedule or budget. To achieve greater success, the SAM should be considered in every step of a project” (City of Chicago, 2012). It is the goal of the City of Chicago that the SAM will become the industry standard for sustainability planning and development (City of Chicago, 2012). Although certain elements of the SAM are specifically for Chicago O’Hare International Airport, other airports can use the same general ideas for basis of their own implementation.

The SAM is based on existing federal, state, and local regulations such as the FAA’s Air Quality Procedures for Civilian Airports & Air Force Bases, FAA Order 5050.4B, FAA Order 1050.1E, Environmental Impacts: Policies and Procedure, the National Environmental Policy Act (NEPA), the Clean Air Act (CAA), and the Chicago Energy Conservation Code (CECC 2008) with additional supplemental strategies to improve sustainability. The chapters in the SAM include: Administrative procedures, Design/Construction, Planning (in-process of developing), Operations and Maintenance (in-process of developing), and Concessions & Tenants (in-process of developing). The SAM is even printed on 100% Certified recycled paper made with renewable wind energy (City of Chicago, 2012).

The administrative procedures chapter is the first in the SAM. It sets the mood for the entire document by establishing green initiatives at the administrative level. The administrative procedures are intended to be applied to any type of project in everyday applications (City of Chicago, 2012). Administrative procedure topics include: Green Meetings, Document Reduction and Recycling Initiative (DRRI), and Establish and Adopt a Corporate Sustainability Policy. Meetings are to be “green” meetings which

include: conserving resources, reducing environmental impacts, save money, and supports commitment to environmental stewardship. Meetings are to be held over conference calls or video calls to save travel time/money when possible. The purpose of DRRI is to reduce the volume of paper and facilitate the recycling of documents (City of Chicago, 2012).

In the Design/Construction chapter the SAM has developed a Green Airplane Rating System to designated sustainability achievement levels with a “Green Airplane Certification” symbol (City of Chicago, 2012, p. 33). “The Sustainable Airport Manual Green Airplane Rating System consists of all the points available for each credit, by project category, for each checklist” (City of Chicago, 2012, p. 275). This chapter is the older version of the SDM with the addition of the “Green Airplane Rating System”. It goes in depth on design and construction of: Sustainable Site Management, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, O’Hare Facility Operations, OMP Intertask Resource Coordination, and OMP Construction Practices. In each subsection there are the allotted sustainability points. The higher the efficiency level the higher the points received. Many of the subsections have included various case studies to show where the recommendations are derived from. The chapter concludes with a table of all available points for the Sustainable Airport Manual Credits.

The Planning, Operations and Maintenance, and Concessions & Tenants chapters are still in the process of being developed. As mentioned earlier, the SAM is a “living” document, continuing to grow as the OMP moves closer to completion. The SAM, along with the Transportation Research Board’s (TRB) Airport Sustainability

Practices document, are great resources to consult when beginning to plan and design a green building project.

San Diego's Green Build

Similar to Chicago O'Hare International Airport, San Diego International Airport (SDIA) is currently in the largest improvement project in the airport's history. San Diego International Airport is the nation's busiest single runway commercial airport serving the needs of the Southern California Region for over 80 years. "Nearly 17 million passengers traveled through the airport in 2009, and this number is projected to increase to 27–33 million by 2030. To accommodate this increase in demand, SDIA is moving forward with much-needed improvements to the airport that will enhance the traveler's experience and improve the airport's efficiency," (San Diego County Regional Airport Authority (SDCRAA), 2010, p. 1).

The Green Build is a result of the City of San Diego's commitment to the environment and economy (SDCRAA, 2010). The Green Build project will help create over 1,000 new jobs and give small businesses opportunities to contract work (SDCRAA, 2010). The project will add 10 new gates to help reduce terminal congestion and increase comfort for passengers traveling in or out of San Diego. There will be the addition of curbside check-in that will allow passengers to check in, print boarding passes and check baggage before entering the terminal at an easy-to-use curbside kiosk (SDCRAA, 2010, p. 1). A new modern dual-level roadway will be added for arriving and departing passengers to allow for more efficient flow of traffic. San Diego will also double the amount of security lanes from 6 to 12 to increase passenger flow to the terminal (SDCRAA, 2010). The increased passenger flow will allow for the

expansion of the concession area to provide more shops and dining options (SDCRAA, 2010).

Construction has begun in 2009 with the addition of more aircraft parking. The expected completion date is in the spring of 2013. The City of San Diego places a large commitment to environmental issues and sustainability. SDIA made the environment a top priority in the Green Build and was the first major airport to implement a sustainability policy (SDCRAA, 2010). According to SDCRAA (2010), "The project is designed to achieve Leadership in Energy and Environmental Design (LEED) Silver certification from the U.S. Green Building Council, using "green" design principles such as use of alternative energy sources, recycled materials and renewable resources, leading to decreased water usage and reduced energy consumption (p. 1-2). The airport plans to recycle materials on the construction site, such as concrete, to be reused in the Green Build.

The Green Build is an estimated \$1 billion project. It will increase the airport's economic impact (amount undetermined), creating over 1,000 new jobs in our current struggling economy (SDCRAA, 2010). The Green Build will ensure that SDIA will continue to support the San Diego region's industries. Industries that rely on the airport to continue include tourism, technology, and life science (SDCRAA, 2010). SDCRAA (2010) has been working closely with local and small business to encourage participation in the Green Build (p.2). The participation of local and small businesses will promote help stimulate the local economy. Similar to OMP the Green Build will be funded by user fees such as PFCs, GARBs, airport cash and FAA grants (SDCRAA, 2010). The project is not funded by any additional taxes to the citizens of San Diego.

Los Angeles World Airports

The city of Los Angeles strives to be the greenest and cleanest big city in the U.S. This goal was established in 2007 when Mayor Villaraigosa signed an Executive Order No. 10 to integrate sustainable practices and cutting edge technology into the city's long term plan. To accomplish this goal, the city developed the Los Angeles World Airports Sustainability Plan in April of 2008. The airports include: Los Angeles International Airport (large hub airport), Ontario International Airport (medium hub airport), Van Nuys Airport (GA airport), and Palmdale Regional Airport (GA airport). They self-proclaim themselves as the "Global Leader in Airport Sustainability." The Sustainability Plan details the Los Angeles World Airports (LAWA) practices and goals set forth by the Mayor, City Council and Airport Board of Directors (LAWA, 2008).

The LAWA believes their Sustainability Vision must be embraced by all levels of an organization to be effective (LAWA, 2008, p.3). LAWA recognizes a difference between "green" and "sustainability." LAWA (2008) define green practices as a sole focus on environmental stewardship (p. 3). They define sustainability as integrating economic growth, such as use of local contractors, and social responsibility, such as implementing fair labor practices, in LAWA's operations (LAWA, 2008, p.3). LAWA has Triple Bottom Line philosophy that recognizes success should not only be measured in financial performance but also by impact to the local economy, environment and society (LAWA, 2008, p.3). The three dimensions used for the Triple Bottom Line include: Environmental Stewardship; Economic Growth; and Social Responsibility (LAWA, 2008).

To help set objectives LAWA developed the Sustainability Performance Improvement Management System (SPIMS) (LAWA, 2008). This tool provides LAWA to manage and facilitate its sustainability practices while engaging all levels of the LAWA organization (LAWA, 2008). The SPIMS process uses six activities to integrate sustainability into LAWA's operations (LAWA, 2008, p. 4). The six activities include: Conduct a Sustainability Assessment; Identify Opportunities; Establish Objectives and Targets; Implement Initiatives; Monitor Progress; and Communicate Progress (LAWA, 2008). The goal is to integrate the SPIMS process into every aspect of its operations. LAWA's initial sustainability objectives include the following (LAWA, 2008, p. 8):

- Increase water conservation in all airport facilities and for all operations.
- Increase use of environmentally and socially responsible products.
- Increase recycling and source reduction efforts at all facilities and for all operations.
- Reduce energy usage and increase usage of green power at all airport facilities and in all operations.
- Reduce emissions from all operations including stationary and mobile sources.
- Reduce single occupancy trips to, from, and within LAWA airports.
- Incorporate sustainable planning, design, and construction practices into all airport projects.
- Promote sustainability awareness to airport employees and the greater community.
- Integrate sustainable practices into internal policies, business processes, and written agreements.

The LAWA Sustainability Plan provides a detailed description how to achieve each of these goals.

DFW International Airport

Dallas-Fort Worth International Airport (DFW) has started several sustainable practices including green building standards, air emission reductions, energy efficiency and renewable energy, transportation efficiency and recycling. DFW was also on the committee that helped develop the SAM. In the summer of 2008, DFW launched an airport-wide Sustainability Policy and Program (DFW, 2009). DFW's sustainability initiative is a key component in the airport's strategic plan designed to positively affect the environment, the community, the airport and its employees (DFW, 2009). The DFW Sustainability Model is seen as a business approach that incorporates three aspects: economic growth, social responsibility, and environmental stewardship (DFW, 2009).

DFW implemented the Green Building Standards locally on the basis of the U.S. Green Building Council's LEED for Green Building Design and Construction rating standards. Other guidelines that were noted in the development of the Green Building Standards include: Chicago Department of Aviation SAM, Los Angeles World Airports Sustainable Airport Planning Design and Construction Guidelines, Port Authority of New York and New Jersey Sustainable Guidelines (DFW, 2009). All current and future projects at DFW must follow the DFW Green Building Standards.

The DFW International Airport Board and the Energy Systems Laboratory (ESL) of Texas A&M partnered to implement a Continuous Commissioning (CC) Program to improve energy efficiency in Airport facilities (DFW, 2009). The program optimizes energy use based on actual building conditions and requirements and routinely

achieves 10 – 25% whole building energy cost reductions (DFW, 2009). The CC program uses existing equipment and retrofits it with sensors to efficiently adapt the energy levels. This was first used in 2004 at the Consolidated Rental Car facility at DFW and the Airport's Administration Building (DFW, 2009). In 2008, the program reduced energy consumption in those two facilities by an average of 25% (DFW, 2009). More recently, DFW used the CC program in the Airport's International Terminal and central heating and cooling plant (DFW, 2009). Since the inception of this project in 2008, DFW has an energy savings of more than two million kilowatt-hours and a total cost savings of over \$780,000 in FY2008 (DFW, 2009).

DFW uses sustainable planning when they update and expand facilities such as installing solar panels, planting native drought tolerant plants, installing ultra-low flow plumbing fixtures, as well as using eco-friendly construction materials (DFW, 2012). WaterSense is an EPA partnership program that helps people save water with a product label and provides tips for saving water. WaterSense partners commit to bringing water-efficient products to market, labeling new homes and buildings, and spreading the word about the need for smart water use. (EPA, 2012). "In 2011, DFW became one of the U.S. Environmental Protection Agency's (EPA) WaterSense Partners and the first airport governmental organization to become a promotional partner under the national WaterSense Program" (DFW, 2012, p. 55). This partnership allows DFW to promote WaterSense products and demonstrates water efficiency to millions of passengers annually (DFW, 2012).

Boston Logan International Airport

Boston Logan International Airport is owned and operated by Massport.

Massport first developed its environmental policy in 2000, outlining their commitment to operate all of their facilities in an environmentally friendly way (Massport, 2009). They later developed their first Sustainability Plan which established long and short-term goals to reduce waste and emissions, while also increasing the use of alternative fuels (Massport, 2009 p. 1). As part of the plan, Massport established green building guidelines and Boston Logan became the first airport terminal to be LEED Certified (Massport, 2009). Today they have several LEED Certified buildings including the general aviation facility.

Massport established their recycling program at Boston Logan in 2005 which includes all passenger areas (Massport, 2009). “The program includes recycling of mixed paper and plastic, aluminum and glass, and the primary goals are to reduce solid waste and increase awareness about recycling. Several airlines at Logan recently started recycling trash from aircraft” (Massport, 2009, p. 1).

As part of the Sustainability Plan, Massport developed their Environmental Management Systems (EMS). The EPA (2012) defines EMS as, “a framework that helps a company achieve its environmental goals through consistent control of its operations. The assumption is that this increased control will improve the environmental performance of the company” (p. 1). The EMS is a continuous improvement cycle of Commitment, Planning, Implementation, Evaluation, and Review (EPA, 2012). The EPA (2012) states, “EMS is a tool that helps in sustainability planning by addressing non-regulated issues, such as energy conservation, and can promote stronger operational control and employee stewardship” (p. 1). EMS allows Boston Logan to manage their impact on the environment by measuring the impacts of activities (Massport, 2009).

Their EMS is International Standards Organization (ISO) 14001 certified, which is focused on minimizing harmful effects on the environment. At Boston Logan, the field maintenance facility is ISO certified and they are developing EMS for other facilities throughout the airport.

Boston Logan International Airport has several other innovative initiatives to increase environmental sustainability including the Logan Air Quality Initiative (AQI). The AQI is a voluntary emissions reduction initiative created to keep nitrogen oxide emissions associated with the airport below levels from 1999 (Massport, 2009, p.2). To help achieve this Logan implemented goals to increase High Occupancy Vehicle (HOV) riders. HOV ridership is around 30% which is only second to San Francisco International Airport (Massport, 2009). Another method to decrease nitrogen oxide emissions was to create the CleanAir Cabs Incentive. This incentive provides head-of-line privileges to cabs using alternative fuels (Massport, 2009). Another incentive is the Logan Clean Vehicle Preferred Parking Program which provides incentives to passengers that cannot ride in HOV to use an alternative fuel vehicle and get to park closer to entrance (Massport, 2009). As even more incentive, Logan makes it easy to refuel alternative fuel vehicles by providing fueling and charging stations inside the airport property for Compressed Natural Gas, E85 and electric vehicle service.

Another cutting edge technology used at Logan first was the Warm Mix Asphalt. Massport (2009) spent \$6.3 million repaving Runway 4R/22L with this Warm Mix Asphalt which is 75 degrees cooler than hot mix asphalt resulting in nearly 2,000 fewer tons of carbon dioxide emissions (p.2). Additionally, approximately 18% of the asphalt used at the airport was made from recycled materials (Massport, 2009, p. 2). Massport

believed this project to be a great success and will continue to use this technology in future pavement projects (Massport, 2009).

Seattle-Tacoma International Airport

Seattle-Tacoma International Airport (Sea-Tac) is owned and operated by the Port of Seattle. The Port of Seattle's vision is to become the cleanest, greenest, most energy efficient port in the nation (Port of Seattle, 2011). To help achieve this vision the Port of Seattle established these specific 25-year Environmental Goals (Port of Seattle, 2011):

- Reduce air pollutant emissions by 50% from 2005 levels².
- Lead our industry's greenhouse gas (GHG) reduction strategies by reducing carbon emissions from all port operations by 50% from 2005 levels and reducing aircraft-related GHG emissions at Sea-Tac by 25%.
- Meet future growth in energy usage through conservation and renewable sources.
- Restore, create, and enhance 40 additional acres of habitat in the Green/Duwamish watershed and Elliott Bay.
- Prevent sprawl in less developed areas of Puget Sound by anchoring our region's urban industrial land use.
- Ensure all storm water leaving port operated facilities meets or exceeds agency requirements and create partnerships that lead our industry in storm water quality improvements.

² 2005 was the first year Sea-Tac began implemented voluntary low emissions programs.

The Port of Seattle has the reputation to be *The Green Gateway* because of its commitment to sustainable development practices and environmental stewardship (Port of Seattle, 2011). Their efforts have won the Vision 2040 Award for Clean Air Strategy for the LEED Certified Consolidated Rental Car Facility, Noise Abatement, and Recycling (Port of Seattle, 2011).

The Rental Car Facility at Sea-Tac was completed in the spring of 2012. The facility was designed and constructed using the U.S. Green Building Council's LEED guidelines (Port of Seattle, 2011). The project spanned over 23-acres and offered efficiency in heating, cooling, and ventilation (Port of Seattle, 2011). The interior of this facility used all organic products including paints, sealants, adhesives, and carpeting (Port of Seattle, 2011). During the construction of this rental car facility, 96% of the excess building materials were recycled (Port of Seattle, 2011).

Noise is another area for environmental concern because of the effect it can have on people living and working near the airport. Sea-Tac operates a comprehensive aircraft noise reduction program which includes a sound insulation program as well as noise abatement programs. The sound insulation programs install noise dampening insulation in airport surrounding homes and schools (Port of Seattle, 2011). The program first began in 1985 and the program has sound proofed nearly 9,300 single family homes, 6 condominiums complexes, 7 of the 15 schools, and two churches (Port of Seattle, 2011). The program has also acquired and relocated over 1,400 single family homes and mobile parks (Port of Seattle, 2011). Aircraft also have to follow noise restrictions according to the Noise Abatement Programs. This program limits aircraft noise while on the ground or flying over densely populated areas. Aircraft must

follow Sea-Tac's noise abatement procedure and aircraft engine maintenance run-ups rules and regulations (Port of Seattle, 2011). Sea-Tac's innovative Fly Quiet Incentive Program awards airlines that are most compliant with noise abatement flight paths and on overall noise levels in the air and on the ground (Port of Seattle, 2011).

Sea-Tac operates a 2011 King Company Best Workplaces to Recycle Award winning Airport's Waste Reduction and Recycling Program. This program manages service, provides public outreach, and coordinates with airport staff and tenants to minimize waste into the landfills (Port of Seattle, 2011). Sea-Tac set a goal to recycle 50% of solid waste from the airport by 2014 (Port of Seattle, 2011). Inside the terminals, passengers have the option to recycle into various bins for different materials (Port of Seattle, 2011). The airlines also are encouraged to recycle waste from the aircraft as they deplane (Port of Seattle, 2011).

Fresno Yosemite International Airport

Fresno Yosemite International Airport is a small hub airport located in Northern California. In 2009, the FAA selected Fresno Yosemite as one of just 10 airports nationwide to participate in the Airport Sustainable Airport Master Plan pilot program (City of Fresno, 2012). Fresno Yosemite chose to use the Sustainable Management Plan for the FAA pilot program (City of Fresno, 2012). In a Sustainable Management Plan, the first step is to gather baseline information on categories such as energy consumption, recycling, and water consumption (City of Fresno, 2012). Once these baselines are established, the airport can set goals with milestones for achieving reduction of those categories. The areas defined in the management plan as having the greatest impact on the airport's overall sustainability were energy usage, water usage,

and air quality (City of Fresno, 2012). Some notable sustainability projects completed at Fresno Yosemite include: utilization of all-green cleaning materials at the airport, installation of synthetic grass to reduce maintenance and irrigation, installation of solar panels that provide sixty percent of the airports power consumption, a consolidation car rental facility that reduces the need for excessive shuttles and staff, established recycling program at the airport, and replaced all recessed lighted with indirect lighting to reduce power and heat (City of Fresno, 2012). The Sustainable Airport Management Plan identifies areas of strong points and opportunities for improvements in water usage. The strong points are that the car rental facility recaptures close to one hundred percent of the water for recirculation. The Plan states opportunities for improvement in water usage are to replace all water fixtures with more efficient low flow fixtures containing the EPA's WaterSense label as well as a system to reuse non-potable water for use of irrigation and toilets (City of Fresno, 2012).

DRAWING LESSONS

As green initiatives become more popular and increasingly regulated, it is important to learn how to implement a sustainability program at an airport. In order to implement a sustainability plan at an airport the airport must first determine its motivation. A survey conducted by ACRP (2008) focused on the motivations behind sustainability practices already implemented in airports (p.9). The top answers from the survey were: state/regional regulations, airport policy, federal regulations, corporate responsibility, stakeholder concerns/ relations, city/local regulations, global trends, economic incentives, and customers (ACRP, 2008, p. 9). A large hub airport will have different motivations to implement a sustainability program than a medium or small hub airport. In a survey conducted by ACRP (2008), respondents' at large hub airports indicated that the main drivers for sustainability practices were state/regional regulations and airport policy (p. 10). In the same survey, respondents at medium hub airports said that the main drivers were corporate responsibility or ethics of the business and state/regional regulations while at small hubs the top two were Stakeholder concerns/relations and state/regional regulations (ACRP, 2008). It is clear that state/regional regulations are one of the main drivers for sustainability; however, many airports go above and beyond the requirements. By going above and beyond any regulations, airports can save even more operating expenses. Also, airports want to have a positive perception with the community they serve. If the community views the airport as wasteful or harmful to the environment, they may lose passengers.

Large, medium, and small hub airports may have different priorities like they have different drivers. Each airport must evaluate their current practices and determine what their priorities will be moving forward with their sustainability plan. The next step is to determine any barriers to sustainability as mentioned earlier. The main barrier to implementing sustainable practices identified by the ACRP survey was funding. Airports must determine where they can get funding to implement the sustainability plan. If money is scarce, an airport can start implementing a small aspect of the plan and build on it once money become available. For example, an airport can install low flow toilets and faucets with automatic shut off to save money on the water bill. As the money increases from the savings they can implement a new aspect to their plan. Once the funding is determined the airport must determine how to govern the sustainability plan.

Governance of the sustainability plan tends to differ amongst the large, medium, and small hub airports. ACRP (2008) states that large hub airports have more staff and more buildings to maintain so the airport tends to have one person dedicated to manage their sustainability program. This is key because the person dedicated to manage a sustainability program can focus solely on improving sustainability, whereas at a smaller airport with less staff may have to manage several programs and departments. Medium hub airports tend to have specific roles for each area such as manager of environment and manager of engineering (ACRP, 2008). The issue with having a manger of the environment is that person has to manage the sustainability program and any other environmental issues such as EPA requirements. Small hub airports tend to have a smaller staff, which results in the sustainability program being managed by staff with

more responsibilities such as the assistant airport director or financial director (ACRP, 2008). Whoever is managing the sustainability program, it is important to have airport staff trained and familiarized with the sustainability program so they can properly administer the plan.

Sustainability performance at the airport should be publicly reported. “The benefits of public reporting include increased transparency and accountability, improved stakeholder relationships, and the ability to benchmark performance against peers” (ACRP, 2008, p. 15). It is common for airports to report financial performance such as airport revenue and expenses, however, reporting the sustainability performance such as goals accomplished and money saved can only strengthen the relationship with stakeholders and community by providing a commitment to accountability, transparency and improvement (ACRP, 2008). An easy way to share sustainability performance is through the airport’s annual report.

A sustainability plan has many benefits such as establishing baselines and setting goals to increase efficiency and energy savings. Sustainability plans identify when and how the airport will meet this goals at the airport. While initial costs may tend to be high, it is worth the financial investment to become sustainable. For example, the CC program at DFW reduced energy consumption in two facilities by an average of 25% (DFW, 2009). An airport can end up savings thousands on the energy cost. Another cost-effective way to go green is by implementing a recycling program. Recycling construction materials for use at other areas or project can offer a huge cost savings by not having to buy dirt or concrete. For example, the materials excavated from a runway project at Sea-Tac were used as fill dirt for a new parking garage.

Recycling inside the airport terminal may not provide much financial benefits, however, the airport's public perception will be viewed positively and in turn may have a secondary impact on the amount of people willing to choose that airport. All airports have a community they serve whether large or small. Airports tend to be the main economic driver in communities because they provide jobs and business to the surrounding communities. An airport that has a sustainability plan can have huge influence and effect on the community. The community will have a positive outlook on the airport because it is working towards becoming sustainable. For example, water is a finite resource, so Fresno Yosemite International Airport, implemented a system that recaptures nearly one hundred percent of the water from the cash washes at the rental car facility. The water is then reused to save the local communities clean water source. Having a sustainability plan, Fresno Yosemite can reuse that same waste water for irrigation. The airport and community provide a strong relationship because neither one could be as successful without the other.

CONCLUSION

Airport operators across the country are beginning to implement sustainability programs and initiatives at their airports. One reason for this are federal and state regulations such as the Air Quality Procedures for Civilian Airports & Air Force Bases, FAA Order 5050.4B, FAA Order 1050.1E, Environmental Impacts: Policies and Procedure, the National Environmental Policy Act (NEPA), and the Clean Air Act (CAA) that encourage airports to develop a sustainability program. Many airports are implementing sustainability programs because they believe it will help meet environmental, economic and social benefits to the community. The research question for this paper was, “How are large hub airports implementing sustainability practices and which sustainability practices used at large hub airports could apply to medium and small hub airports?”

Every sustainability plan is unique and the airport should modify and scale their approach based on its specific operating environment and resources (SAGA, 20

Large hub airports are implementing large scale sustainability plans such as at Chicago O’Hare, San Diego, Los Angeles World Airports, Boston Logan, DFW and Sea-Tac. These sustainability program take into consideration aspects of the environment, community, economy, and operations. Some specific factors that are driving airports to sustainability are rising energy costs, airline financial pressures, resource conservation, aging infrastructure, and new technologies. Airports that are going green using sustainability practices are gaining substantial benefits including reduced operational costs, reduced capital asset life cycle costs, greater utilization of assets, improved

benefits to the community, optimization of new and better technologies, as well as reduced environmental, health and safety risks.

The literature also shows that small and medium hub airports can implement the same types of sustainability programs as large hub airports. For example, LAWA have a sustainability plan that applies to four different sizes and types of airports: Los Angeles International Airport (large hub airport), Ontario International Airport (medium hub airport), Van Nuys Airport (GA airport), and Palmdale Regional Airport (GA airport). LAWA has Triple Bottom Line philosophy that recognizes success should not only be measured in financial performance but also by impact to the local economy, environment and society (LAWA, 2008, p.3). The three dimensions used for the Triple Bottom Line include: Environmental Stewardship; Economic Growth; and Social Responsibility (LAWA, 2008). LAWA believes the sustainably plan must be embraced by all levels of an organization to be effective (LAWA, 2008). LAWA outlines goals and actions to be implemented by each of the four airports. In this case the size of the airport doesn't affect the goals of the organization. The only differences are the magnitude of the programs because they vary with the size of the airport such as the difference in the program at Los Angeles International and Van Nuys Airport. Small hub airports such as Fresno Yosemite International can still implement the same goals and programs as Chicago O'Hare or DFW. For example, Fresno Yosemite has a similar plan to DFW to conserve water and energy by installing low flow plumbing fixtures and energy efficient lighting. Another example that a large hub airport would consider rather than a smaller airport would be to implement an airport wide recycling program. This recycling program would not be a cost-effective way for smaller airports to operate.

This is not to say smaller airports can't recycle, but rather that a full recycling program may be an inefficient use of resources. However, the content for developing and implementing a sustainability plan does not change based on the size of the airport.

The literature suggests the main difference when implementing a sustainability plan at large hub airport or a medium and small hub airport is the magnitude and cost-benefit based on each individual's airport's needs.

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