

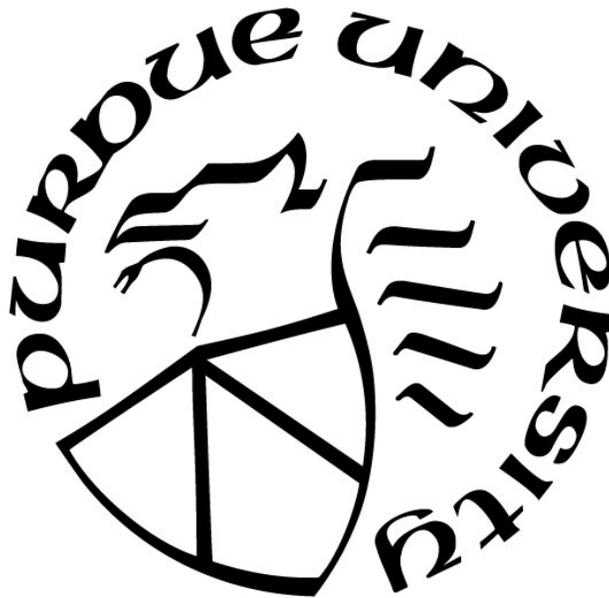
**INCORPORATING SUSTAINABILITY PLANNING IN AIRPORT
MASTER PLANS
A CASE STUDY OF SIX U.S SMALL HUB AIRPORTS**

by
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A Thesis

*Submitted to the Faculty of Purdue University
In Partial Fulfillment of the Requirements for the degree of*

Master of Science in Aviation and Aerospace Management



School of Aviation & Transportation Technology
West Lafayette, Indiana
May 2019

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For my dearest Aunt Jane...

ACKNOWLEDGMENTS

I am grateful to my committee members Dr. Mary Johnson (Chair), Dr. Richard Fanjoy and Dr. Flavio Mendonca for their endless support and encouragement through the thesis writing process. I greatly appreciate the Fulbright Foreign Student Program for the financial support in making my dream of studying at Purdue come true.

I thank my family and friends back home in Kenya and in the United States for their support in the form of oddly timed overseas calls and ever timely messages that have all become my source of inspiration.

Finally, I thank the Almighty for the silent moments, and for Your power that I can barely comprehend.

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GLOSSARY

Airport Improvement Program (AIP) — is a program funded by the Federal Aviation Administration to provide financial support to airports included in the National Plan of Integrated Airport Systems (FAA, 2019).

Commercial Service Airport — “A publicly owned airport that has at least 2,500 passengers boarding each calendar year and receives scheduled passenger service” (FAA, 2018, para. 2).

GRI Sustainability Reporting Standards (GRI Standards) — A set of standards aimed at helping companies and public agencies to plan and communicate sustainability issues to their stakeholders (GRI, 2019).

Small hub airport — “A Commercial Service Airport with at least 0.05%, but less than 0.25% of Commercial Service Airport percentage of annual Passenger Boarding” (NPIAS, 2018, p. 67).

Sustainable Aviation Guidance Alliance (SAGA) — A searchable database formed in 2008 by a consortium of aviation interest groups to assist airport managers in incorporating sustainability in airport planning (SAGA, 2019).

Sustainable development — “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Economic Development (WCED, 1987, p. 37).

Sustainable transportation — adopted from the WCED definition, it means supporting the present transport needs in a manner that allows future generation to enjoy the benefits of a good transport system (Black, 1996).

LIST OF ABBREVIATIONS

A4A — Airlines for America.

AAAE — American Association of Airport Executives.

ACC — Airports Consultant Council.

AIP — Airport Improvement Program.

ACI — Airports Council International.

ACI-NA — Airports Council International, North America.

ATAG — Air Transport Action Group.

ABBB — Aviation Benefits Beyond Borders.

EONS — Economic, Operational, Natural resources, Social.

FAA — Federal Aviation Administration.

GRI — Global Reporting Initiative.

ISI — Institute for Sustainable Infrastructure.

NPIAS — National Plan of Integrated Airport Systems.

SAGA — Sustainable Aviation Guidance Alliance.

CDP — Carbon Disclosure Project.

ABSTRACT

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Institution: Purdue University

Degree Received: May 2019

Title: Incorporating Sustainability Planning in Airport Master Plans.

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The Federal Aviation Administration (FAA) *Report on the Sustainable Master Plan Pilot Program and Lessons Learned* published in December 2012 showed that airports of all sizes can benefit from incorporating sustainability in their master plans. Global aviation organizations such as the International Civil Aviation Organization (ICAO) and Airports Council International (ACI) have been in the forefront in championing aviation sustainability. While incorporating sustainability in airport planning is highly encouraged, there are challenges associated with such a process. Some of the challenges experienced by airport managers in planning and implementation sustainability are lack of financial capability, and lack of skilled sustainability specialists. In 2009, FAA launched the Airport Sustainability - Airport Improvement Program (AIP), to provide grants to airports that were willing to invest the time and resources in preparing airport master plans that incorporate sustainability issues. To date, 44 airports have been funded through the FAA Airport Sustainability AIP grant. Six of the 44 airports are in the category of small hub airports as classified by the National Plan of Integrated Airport Systems (NPIAS). The objective of this study is to gain an in-depth understanding of the approaches to sustainability planning used by the six small hub airports in the FAA program. The researcher chose a case study design to conduct an exploratory case study with multiple cases. The results of the study show that the approaches used by the six airports vary depending on the specific airport needs and resources available. Based on the study results, the researcher concludes there are more similarities than differences in the approaches airports have used to incorporate sustainability in the master planning process.

CHAPTER 1. INTRODUCTION

The air transport industry is one of the fastest growing industries in the world. It is estimated that global air transport industry will experience a 4.7 percent annual growth in traffic for the next 20 years (Boeing, 2017). A growing air transport industry is representative of several benefits to an economy including increased global trade and easy movement of people and cargo across borders. Additionally, the industry provides employment to about 65.5 million people globally (ATAG, 2019; IATA, 2019). To accommodate the increasing number of travelling passengers, the Boeing Company Report, *Current Market Outlook* predicts that between 2017 and 2021, governments and other airport owners will spend approximately 1 trillion U.S dollars on developing new and expanding existing airports (Boeing, 2017). Despite the many economic and social benefits of the air industry, the industry has been noted to have negative impacts that should not be ignored (ATAG, 2019; Janic, 2007; 2010). Increased air travel means more aircraft in the air and perhaps increased emission of greenhouse gases (GHG) among other environmental, social and economic impacts (ATAG, 2012). In order to minimize the industry's negative impacts and continue increasing the benefits to the society, companies must operate in a sustainable manner.

Our Common Future, also known as *The Brundtland Report*, prepared by the World Commission on Environment and Development (WCED) and published by the United Nations, defined sustainable development as “Development that meets the needs and aspirations of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p. 37). In defining a sustainable transport system Richardson (1999) emphasizes the need to maintain safety in transport and the added value of replacing fossil fuels with renewable energy sources (Richardson, 1999). Continued emission of greenhouse gases has been known to be one of the causes of global climate change. More recent studies show a need for sustainability focused research in the air transport industry (Malick, 2016).

A closer look at the aviation industry reports indicate that industry stakeholders acknowledge the need to operate profitable and sustainable organizations. Airports Council International - North America (ACI-NA), a trade organization for airports globally, defines airport sustainability as “a holistic approach to managing an airport to ensure the integrity of the Economic viability, Operational efficiency, Natural Resource Conservation and Social responsibility of the airport” (ACI-NA, 2017). The EONS definition of sustainability has been adopted by many

airports in incorporating sustainable airport planning and implementing sustainability projects. According to ACI-NA Environmental Affairs Committee, 59% of Canadian and US airports had adopted sustainability policies by 2015 (ACI-NA, 2017). To encourage adoption of sustainability policies, ACI-NA holds annual events to acknowledge and reward airports that adopt and follow through in managing sustainability projects. Organizations that adopt sustainability measures may choose to include their sustainability report as part of the annual company report. The KPMG 2017 *Corporate Social Responsibility Report* shows that more airlines, parts manufacturers and original equipment manufacturers (OEMs) are voluntarily adding sustainability reports to their annual corporate reports (KPMG, 2017).

One of the challenges in reporting sustainability is the lack of standardized reporting frameworks (Janic, 2010). In North America and Europe regions where sustainability reporting is on the rise, sustainability reporting remains a voluntary business practice. The variations in methods of reporting makes it difficult to evaluate the level of reporting using a standard system (KPMG, 2017). Africa and Asia regions have the lowest reporting rate by any standard (KPMG, 2017). The KPMG *Corporate Social Responsibility Report* argues that one of the major contributors to the high rates of reporting in the United States is the establishment of the Sustainability Accounting Standards Board (SASB) (KPMG, 2017). SASB is an independent globally focused standards board that provides guidance for companies “to identify, manage and communicate financially-material sustainability information to their investors” (SASB, 2019, para. 1). Whereas SASB focuses on financial sustainability, there are other organizations that provide a more expansive framework for sustainability reporting. For instance, The Global Reporting Initiative (GRI) emphasizes on the importance of including the organization’s impact on “climate change, human rights, governance and social wellbeing” (GRI, 2019, para. 1). Additionally, GRI has developed sector specific reporting standards including standards for airport operators.

Small and medium sized organizations have a lower sustainability reporting rate compared to multinational organizations. Studies have shown that small and medium sized organizations such as small hub airports face the challenge of lack of financial and skills resources, and generally do not consider sustainability issues a priority (Janic, 2010; Martin-Nagle & Klauber, 2012; Landrum & Brown, Inc., Environmental Consulting Group, Primera Engineers & Muller & Muller, 2012; & Malick, 2016). A small hub airport is a primary commercial airport “that enplane 0.05 percent to 0.25 percent of total U.S. passenger enplanements” (NPIAS, 2018, p. 6).

1.1 Problem Statement

Incorporating sustainability in the airport master planning process is an expensive undertaking for most organizations. This process may be even more resource consuming for small and medium sized organizations (Martin-Nagle & Klauber, 2015). For instance, companies that report successful implementation of sustainability initiatives in their organizations also report investment of time by senior leadership team. Additionally, a substantial amount of finances is invested in implementing a successful project (Prather, 2016; Berry, Gillhespy & Rogers, 2008). Additional costs may be incurred in acquiring subject matter experts to oversee the projects and continue the monitoring process after implementation. The benefits of sustainability planning and reporting may be overlooked by managers because sustainability planning and reporting is not a legal requirement (Landrum & Brown, Inc. et al., 2012). The challenges of sustainability planning are further exemplified by the lack of standardized approach to sustainability planning in many industries (KPMG, 2017). In the airport industry, airport managers interested in undertaking sustainability focused projects take different approaches to identify and implement sustainable airport improvement projects. Where airport resources are limited, sustainability may not be a priority for most airport managers. The few projects that may gain attention are likely to focus on economic and environmental benefits (Landrum & Brown, Inc. et al., 2012). The objective of this study is to provide an in-depth analysis on the approaches used by six small hub airports to incorporate sustainability in airport master plans. The researcher seeks to illuminate the benefits of sustainability planning for small hub airports and provide information that may be used by other small hub airports to incorporate sustainability planning in airport master plans.

The six small hub airports in the study are part of the FAA Airport Sustainability AIP Program launched in 2009. The AIP grant allowed airports to conduct studies on their current airport resources and identify strategies for incorporating sustainability in airport master plans. The recommended sustainability strategies focus on reducing the airports' impact to the environment, improving operations of the airport to maximize economic benefits and strategies for including the local communities in airports' decision-making process. To date, 44 airports across the US have been funded (FAA, 2019). The six small hubs airports included in the FAA study are:

- Akron Canton Regional Airport;
- Fresno Yosemite International Airport;
- Huntsville International Airport Carl T. Jones Field;
- James M. Cox Dayton International Airport;
- Northwest Arkansas Regional Airport; and
- Portland International Jetport.

This study contributes to the body of knowledge on sustainability planning by providing an in-depth understanding on the approaches to sustainability planning for small hub airports in the United States.

1.2 Research Questions

This study attempts to answer two research questions.

1. What are the definitions of airport sustainability used by each of the six small hub airports?
2. What are the approaches to sustainability planning adopted by small hub airports?
 - a. What are the similarities and differences in the approach to sustainability planning?
 - b. What sustainability initiatives have been undertaken by small hub airports?

1.3 Significance

There are many benefits to including sustainability in airport master plans. Some of the benefits include: reducing the amount of energy consumed in airport operations, better waste management strategies, better partnerships with the local communities and ultimately cost saving for the airport (Black, 2010). The traditional airport master plan focuses on the adjustments required to meet forecasted airport demand. In the recent years, the environmental impacts of airports have become an issue of priority. Incorporating sustainability in the planning phase allows airport management to plan and implement projects that present the maximum sustainability benefits to the airport. Studies on airport sustainability are highly focused on the environmental impacts of large airports operations (GRI, 2019; Landrum & Brown, Inc. et al., 2012; Martin-Nagle & Klauber, 2015). A general viewpoint is that larger airports with higher number of operations have a bigger impact on the environment and the communities around them. Small and medium hub airports are less frequently studied (Prather, 2016). In the current operating environment, airports are encouraged to view sustainability from different perspectives and not focus on a single area of sustainability (Black, 2010).

1.4 Scope

The FAA Airport Sustainability Planning grant is an FAA Airport Improvement Program that provides grants to eligible airports across the United States to develop comprehensive sustainability documents. Airports awarded the grant may prepare a sustainability master plans - a plan that incorporates sustainability in the traditional master plan and therefore all airport projects include a sustainability aspect; or an airport sustainability management plans - an independent sustainability documents that focuses on specific areas of sustainability without affecting the overall airport plan (FAA, 2019). This study focusses on the approaches for incorporating sustainability projects in the master planning process in small hub airports. The researcher used a case study research design with an exploratory approach. The case studies selected for the study are limited to the six small hub airports included in the FAA Airport Sustainability Planning AIP grant list (FAA, 2019). The study uses qualitative data obtained from the airport documents, primarily the airport sustainable master plan or the sustainability management plan are used. Airports websites content is used where available. Other data sources include airports social media feeds and news releases. The researcher attempts to draw a comparison on the similarities and differences in the approaches to sustainability planning used by the six airports. The study identifies the sustainability initiatives included in the airport sustainable master plans.

1.5 Assumptions

Based on the case study research design, the researcher made these assumptions:

- There no universal definition of sustainability for airports.
- There is no standardized approach to airport sustainability planning.
- Airport management are concerned and want to incorporate sustainable projects in airport master plans.
- Information provided in the sustainability documents is accurate.
- Multiple case study approach is the most suitable approach for this type of study.

1.6 Limitations

The limitations of the study are:

- The literature review was limited to materials available through the Purdue Libraries and online accessible reports.

- The study is limited to the documents of the six small hub airports in the FAA Sustainability planning AIP program from 2010 to 2018.
- The quality of reporting is not examined.
- The researcher uses data as reported and therefore this study does not include verification of the credibility of the reporting criteria used by the airport management.

1.7 Delimitations

The delimitations of the study are:

- The researcher did not study airports outside of classification of small hub under the NPIAS classification.
- The study was limited to airports in the USA.
- The study included only the six small hub airports that qualified and were funded by the FAA sustainability planning AIP grant.

CHAPTER 2. REVIEW OF LITERATURE

To conduct the literature review, relevant terms were submitted to the Purdue Libraries academic journals databases. The relevant terms were sustainable development, airport sustainability, sustainable air transportation systems, and sustainability reporting. Documents were also retrieved from credible aviation related organizations websites such as Transport Research Board (TRB), Airports Council International (ACI), Federal Aviation Administration (FAA) Airport Sustainability website and Air Transport Action Group (ATAG). The literature is reviewed under the following topics: sustainable airport systems, incorporating sustainability in airport planning, and sustainability reporting frameworks.

2.1 Sustainable Airport Systems

Sustainability is much more than environmental preservation (Prather, 2016). Since the publication of the *Brundtland Report* (WCED, 1987), the concept of sustainable development has been adopted in many industry reports. However, there are industries that have not fully adopted sustainability reporting. The air transport industry is one of the least researched industries on sustainability issues (Janic, 2010). There are efforts by air industry stakeholder to promote a sustainable air industry. For instance, in 2008, leaders from American Association of Airport Executives (AAAE), Airports Consultant Council (ACC), Federal Aviation Administration (FAA), Airports Council International-North America (ACI-NA), and Airlines for America (A4A) among other consultants came together to form the Sustainable Aviation Guidance Alliance (SAGA). SAGA is a searchable database that can be used by airport managers in incorporating sustainability in airport planning and project monitoring (SAGA, 2019). These efforts also resulted in the *Sustainable Aviation Resource Guide*, a comprehensive consolidation of existing guidelines and practice on airport sustainability (SAGA, 2019). SAGA project materials are available for free on the SAGA website and are accessible to airport managers and the general public.

On a global outlook, the GRI Standards have been widely used in the aviation industry, more so by airlines (Rudari, 2017). GRI Sustainability Reporting Standards (GRI Standards) expand the focus of sustainability to more than one area of sustainability. GRI Standards may be used by businesses and public agencies to plan and communicate sustainability issues to stakeholders (GRI, 2019). In addition to the general industry guidelines, GRI issues sector specific

guidelines. For instance, the G4 Sector Disclosures, Airport Operators Sector Disclosures provide a set of disclosures specific and relevant to the preparation and reporting sustainability for airports. The GRI Airport Operators Sector Disclosures provides guidance in six areas: economic, environmental, labor practices and decent work, human rights, society and product responsibility (GRI, 2019). Despite the adoption in many global industries, GRI standards approach on sustainability reporting has been criticized as being “myopic and inwardly focused, concern largely bereft of ecological understanding” (Milne & Gary, 2012, para. 3). Milne and Gary (2012) argue that the GRI framework fails to definitively define sustainability and organizations that use GRI reporting are not necessarily concerned with the actual impacts of their operations to the environment but rather are jumping on the reporting bandwagon so as not to be left behind. One might argue that since 2012 when Milne and Gary (2012) presented their argument, GRI has revised their framework to make it more relevant to sustainability reporting in present times.

The argument on the definition of sustainability and the benefits of sustainability reporting remains inconclusive. (Janic, 2007) argues that the impact of the air transport industry on the communities will continue to increase. In March 2012, aviation industry leaders through the Air Transport Action Group (ATAG) renewed a commitment to continue advocacy for climate change initially signed in 2008 (ATAG, 2012). To date, ATAG members continue to set industry goals and find innovative ways to meet them. One of the goals set by ATAG is improving fuel consumption efficiency. Since 2008, fuel efficiency in the air transport industry has seen a significant improvement of 1.5% per year and is projected to stay on track through 2020 (ATAG, 2012). In addition to promoting sustainable air transport development, ATAG through its members, have developed partnerships to develop skilled manpower to meet future aviation needs. The goals and actions of ATAG as with many industry organizations is in line with WCED and other definitions of air transport sustainability, that is, increasing positive impacts and minimizing the negatives impacts of the aviation industry to the society. One may argue that the sustainability goals set jointly by ATAG members provide insight to the industry definition of sustainability.

ACI-NA Airport Sustainability Committee defines airport sustainability as “a holistic approach to managing an airport to ensure the integrity of the Economic viability, Operational efficiency, Natural Resource Conservation and Social responsibility (EONS) of the airport” (as cited in SAGA, 2015, p.8). This definition is in line with the ATAG pillars of sustainable air transport industry. Janic (2010), a leading researcher on air transport sustainability argues that

sustainability of airports is gauged by the extent of negatives impacts against positive effect to the community. A sustainable airport minimizes negative impacts and finds ways to increase positive effect to the community in the long term (Janic, 2010).

The EONS framework of sustainability as presented in the ACI-NA definition of sustainability has been widely adopted by airports in the United States. Operational efficiency is one of the additions specific to the EONS framework that is not assessed in other frameworks such as GRI and the Triple Bottom Line (TBL). Increasing an airport's operational efficiency can increase by a significant amount its core saving. Martin-Nagle and Klauber (2015) argue that smaller airports can leap significant benefits from implementing sustainability projects aimed at improving operational efficiency (Martin-Nagle & Klauber, 2015) Installation of LED energy saving light bulb is an example of operations sustainability initiative that has been widely adopted by small and medium hub airports throughout the United States (Prather, 2016). Airports can enhance economic viability by increasing revenue generating projects, finding innovative ways of decreasing project costs, and investment in long term projects with a high return on investment (Martine-Nagle & Klauber, 2015). Environmental conservation as a measure of sustainability has received the most attention by researchers. The threat of depletion of natural resources and the need to reduce damage on the ozone layer are the main drivers for most environmental focused sustainability initiatives. Environmental sustainability is mostly achieved by reducing the amount of greenhouse houses emissions to the atmosphere (Koç & Durmaz, 2015). Natural resource conservation as represented in the EONS sustainability framework is mainly focused on the impact of airport operations to the environment. For instance, if an airport operates near a catchment area, the airport needs to take precautions to maintain the integrity of the natural resource. Waste management projects may also contribute to natural resource conservation dimension of sustainability (Landrum & Brown, Inc. et al., 2012).

While economic and environmental impacts of aviation are evident, social sustainability is highly overlooked (Janic, 2010). Airports operate within communities and should be part of ensuring the sustainable development of the communities around them. For instance, social sustainability means finding ways to communicate airport goals and objectives to the communities around the airport. Engaging the local community around the airport promotes good relationships between the businesses and the people. Airports should also consider supporting the employees that keep the airport business running. Promoting a healthy work life is an equally important aspect

of social sustainability. To the advantage of airports, social sustainability initiatives require minimal financial investment. (Martin-Nagle & Klauber, 2005).

2.2 Incorporating Sustainability in Airport Planning

Currently there is no one accepted definition of airport sustainability. Airport sustainability encompasses a wide range of management practices that ensure successful running of an airport (Black, 2010). The signing of the sustainable development commitment by ATAG members in 2008 is one of the few formal agreements in support of sustainable air transport systems (ATAG, 2012). Airports can benefit from incorporate sustainability focused projects in airport planning. For instance, cost reduction, better partnerships and engagement with the local communities, promoting sustainability practices to employees, tenants and travelers and reducing the airport negative impact to the environment (Black, 2010). An airport master plan is a strategic plan describing the current and future development plans of an airport prepared after a comprehensive study of the airport resources and capabilities (FAA, 2015). Traditionally, airport master plans are developed based on the forecasted airport demands, sustainable airport master plans aim at making sustainability assessment a critical part of decision making for all airport projects (Black, 2010).

To date, most airport sustainability research is focused on large airports (Landrum & Brown, Inc. et al, 2012; GRI 2019). The general view point is that larger airports have a higher number of operations and therefore have a bigger effect on natural resources, social and economic environment. (Landrum & Brown, Inc. et al. (2012) argue that the high number of researches focused on large airports may be attributed to availability of resources to support sustainability project in large airports compared to small airports. Before an airport can embark on a sustainable project, it is important that the idea of sustainability is understood and embraced by the top management (Berry, Gillhespy & Rogers, 2008; Landrum & Brown, Inc. et al., 2012). Embarking on a sustainability master plan update may lead to airport expansion projects which can bring both positive and negative effects to the community around the airport. According to (Janic, 2007; 2010), the positive effects include providing employment and raising the economic value of a location. The negative effects relate to environmental pollution for instance noise, air, land use and waste (Janic, 2007; 2010).

In the next decade, the air transport industry is projected to have a high investments rate in airport (Boeing, 2017). Generally, a high capital investment on infrastructure means the structures are expected to last a long time. High cost investment requires proper planning and

implementation. An organization that hopes to succeed in sustainable development need a dedicated team to oversee implement and continuous monitoring of projects. A *Report on the Sustainable Master Plan Pilot Program and Lessons Learned* published by FAA in 2012 showed that airports that had sustainability champions within the organization reported a more effective implementation of sustainability projects (FAA, 2012). A sustainability champion is an employee or a team of employees who understand sustainability and its benefits to the organization. Sustainability champions take the initiative to promote sustainability issues and explain the benefits to the entire organization (Landrum & Brown, Inc. et al., 2012). Sustainability project objectives should be defined and incorporated in the overall company mission and vision. Airport manager can use decision making tools such as the Airport Sustainability Assessment Tool (ASAT) to conduct a (Landrum & Brown, Inc. et al., 2012).

The success of sustainability projects varies from airport to airport. Most airport managers involved in implementation of sustainability projects do not have enough information on the proper procedures for planning, implementing and monitoring sustainability projects in an airport setting (Berry, Gillhespy & Rogers, 2008). Airport that report successful project implementation will normally have a sustainability champion and a clear sustainability plan (Landrum & Brown Inc. et al., 2012). A lifecycle analysis is equally important in determining the success of a sustainability projects (Landrum & Brown Inc. et al., 2012). Managers are required to plan for the entire process lifecycle and be able to determine the long-term effects of a process. The support of employees is important in project planning and implementation. Employees are more likely to support a project if they understand the project from the beginning stage (Berry, Gillhespy & Rogers, 2008; Black, 2010; Landrum & Brown, Inc. et al, 2012).

The master planning process varies from one airport to another. The planning process is mostly guided by the airport needs and resources available (FAA, 2015). Airport managers must take into consideration various aspects of the airport operations before undertaking sustainable projects. For small and medium operations airports, the amount of resources required to run a successful project is a major consideration (Martin- Nagle & Klauber, 2015). Small hub airport managers may require hiring subject matter experts to assist with planning and successful implementation of sustainability projects. For most small hub airports, the airport manager is the key contact for all sustainability matters. Although the manager might have some knowledge of sustainability planning, it is unlikely that he or she can be an expert in all areas. (Martin-Nagle &

Klauber, 2015). Due to the perceived benefit versus the cost of investment, most airport managers shy away from investing in sustainable airport projects (Martin-Nagle & Klauber, 2015). In most cases, this is seen as an unnecessary investment that should only be undertaken by large airport that have extra resources. However, this is a misguided perception resulting from lack of adequate information on the benefits of sustainable projects. Although sustainable projects have an initial high cost compared to the traditional approach, in the long run, sustainable projects produce a higher benefit to the organization (Landrum & Brown, Inc. et al., 2012). Table 1 shows examples of traditional airport projects and their sustainable alternatives.

Table 1. Examples of Traditional Projects and Sustainable Projects Alternative

Traditional Projects	Sustainable Alternative
<ul style="list-style-type: none"> • Traditional lighting • Traditional windows 	<ul style="list-style-type: none"> • Energy saving lighting • Waste management • Water quality • E-documents

Note. (Landrum and Brown, Inc. et al., 2012)

In designing, implementing, and monitoring sustainability project airport managers need to find the right resources and tools that can be used throughout the process. For instance, Envision[®] developed by Institute for Sustainable Infrastructure is a tool designed to provide guidance on planning and implementing sustainable infrastructure (ISI, 2019). Envision[®] tool allows the decision makers to assess the performance of a project and its benefits to the organization, and to the community (ISI, 2019). Landrum and Brown, Inc. et al. (2012) suggest a process approach when planning and implementing a sustainability project for airports. The process approach considers the overall cost of a project in the long term and its impact to the environment.

The steps are:

Step 1. Establish a vision and mission,

Step 2. Create and document a sustainability plan,

- Step 3. Identify sustainability champions in each department in your organization,
 Step 4. Implement the plan,
 Step 5. Establish objectives and metrics,
 Step 6. Close the feedback loop (Landrum & Brown, Inc. et al., 2012).

The high cost of investment and the extensive process of designing, implementing and monitoring sustainability projects may deter airport managers from undertaking sustainability projects. In 2010, the FAA established the Airport Sustainability planning grant to aid airports in sustainability planning. To date, 44 airports of all categories have received grants to support the process of incorporating sustainability in airport master planning documents. The Airport Sustainability Planning grant encouraged airports to focus on projects that present economic benefits for the airport, minimize impact to the environment and promote partnerships with the local communities (FAA, 2019). Table 2 shows two ways that airports may include sustainable initiatives specific to their airports in their master plans.

Table 2. Two Ways of Preparing Sustainable Airport Master Plans

Sustainable Master Plan	A sustainability planning document that integrates sustainability in the overall planning process of airport projects. This type of plan is most applicable to airports who are in the process of updating their traditional master plan (Black, 2010).
Sustainable Management	A standalone document focusing on specific aspects of sustainability. This document type is most relevant for airports who are not updating their master plan but consider sustainability an important issue to address (Black, 2010).

2.3 Sustainability Reporting Frameworks

A sustainability reporting framework provides the guidelines to be followed in reporting sustainable projects impact to an organization and the organization stakeholders. Common sustainability reporting frameworks include: The triple bottom line (Elkington, 1994) and the Global Reporting Initiative (GRI). GRI was started by the Coalition for Environmentally Responsible Economies (CERES) a US nonprofit organization based in Boston. Tellus Institute and United Nations Environment Program (UNEP) also participated in the initiating GRI (GRI, 2019). In the early 1990s, Elkington (1994) argued that companies should be preparing for three bottom lines: Profit, People, and Planet. Today the three bottom lines have been translated to financial, social and environment. Elkington argued that organization should be concerned with that which is measurable (Economist, 2009). The TBL has evolved to become what is now used by many organizations as the Economic, social and Environmental measures. Although the measures of sustainability continue to change, there is still no one standard reporting framework accepted by all industries (Koç & Durmaz, 2015). In the case of airport industry, Koc and Durmaz (2015) argue that rankings for best airports in sustainability vary significantly depending on the criteria used for analysis. Because of the lack of standardized measures of sustainability, airport managers with input from stakeholders, are mostly responsible for selecting a criterion for planning and reporting sustainability at their airport.

Janic (2007) proposed a twelve-point effect benefits versus impact cost approach model. The model uses a quantitative measure of each of the points that can be used as an indicator for a sustainable airport. However, this approach does not provide a standard formula for quantifying each of the indicators. Table 3 shows the twelve-point approach categorized into four focus areas.

Table 3. Twelve Point Effect Benefit Versus Impact Cost Approach

Operational Performance	Economic Performance	Social Performance	Environmental Performance
<ul style="list-style-type: none"> • Demand • Capacity • Quality of service • Integrated intermodal services 	<ul style="list-style-type: none"> • Profitability • Labor productivity 	<ul style="list-style-type: none"> • Direct and indirect employment by an airport 	<ul style="list-style-type: none"> • Efficient energy use • Noise reduction • Air emissions • Land management and waste management

Note. Twelve Point Effect Benefit versus Impact Cost Approach (Janic, 2010).

The GRI Standards published by (GRI) are sustainability reporting guidelines focusing on the triple bottom line, that is economic, environment and social dimensions of sustainability. GRI argues that their Standards are the first of their kind globally (GRI, 2019). In addition to the general standards, GRI also publishes sector specific guidelines. The Generation 4 (GRI-G4) guidelines are the most widely used reporting framework for most companies globally (KPMG, 2017; Morhardt et al., 2002).

Some sustainability reporting tools are more specific to one area of sustainability. For instance, the Carbon Disclosure Project (CDP) focuses on helping organizations to manage their environmental impact by providing a disclosure system (CDP, 2019). According to *The CDP US Analysis*, a report “based on the climate data disclosed by over 1,000 of the world’s largest, highest emitting companies” (CDP, 2017, p. 4), more organizations are choosing to include long-term plans to reduce GHG emissions in their business plans beyond the year 2030 (CDP, 2017).

2.4 Conclusion

The literature review provides some of the key research found in the area of airport sustainability. The review starts by highlighting the research conducted through the Transportation Research Board (TRB) and some of the leading researchers in the field of air transport. Although the field of air transport sustainability is considered fairly under researched, there are a significant number of studies that provide recommendations for incorporating sustainability projects in airport planning. There are efforts towards finding a standardized airport sustainability planning framework. In comparison to large airports, a gap remains on research related to sustainability planning for small hub airports.

CHAPTER 3. METHODOLOGY

This chapter describes the study methodology. An exploratory case study strategy with multiple cases is used to carry out the research. The procedure used in carrying out the case study analysis is discussed. The researcher describes in detail the proposed method of research analysis, the sources of data and ways of improving validity of the study.

3.1 Research Objective and Research Questions

The objective of this study is to provide an in-depth qualitative analysis on the approach to sustainability planning for small hub airports in the United States. The study identifies the approaches to sustainability planning used by six small hub airports and the sustainable projects included in the airport sustainability plan. The final report resulting from this research may be used as a guide for highlighting sustainability planning for small hub airports.

This study attempts to answer these questions:

1. What are the definitions of airport sustainability used by each of the small hub airports?
2. What are the approaches to sustainability planning adopted by small hub airports?
 - a. What are the similarities and differences in the approach to sustainability planning?
 - b. What sustainability initiatives have been undertaken by small hub airports?

3.2 Theoretical Framework

There are varying definitions of case study research. According to Yin (2003), “a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.” (Yin, 2003, p. 13). Yin’s definition of case study emphasizes the importance of context in conducting case study research. Context distinguishes a case study research from other types of research. For instance, an experiment completely disregards the context and focuses on a selected set of variables. Dul & Hak (2007) argue that case study as defined by Yin (2003) and other researchers fails to show an important distinguishing factor of a case study, that is, case study is an inquisition of one instance referred to as a case ,or a small number of instances called cases (Dul & Hak, 2007). Therefore, (Dul & Hak, 2007) define case study research with an emphasizes on context as

well as the inquisitive nature of case study research. In case study research, theory development is part of the initial stage of preparing for the study (Yin, 1994). Despite the effort to encourage the use of case study as a research strategy, case study research methodology remains largely under developed as a research strategy. The works of (Stake, 1995; Merriam, 1998; Yin 2003) are some of the most widely used guides when it comes to case study research. Although the three authors differ in their approach to case study research, there is a consensus that case study topics may not have an established theory development strategy. In such situations, Yin recommends the researcher take a descriptive theory approach (Yin, 1994). In adopting a descriptive theory approach the author needs to clearly define the scope of the topics that need to be covered for the study to be considered exhaustive. The purpose of the study should also be clearly defined (Yin, 2003). A descriptive approach may be used when a topic has limited existing knowledge base. A case study research is most applicable when a researcher encounters a broad and complex topic with minimal theories available and when context is critical to the study (Dul and Hak, 2007). For this study, the researcher adopted the Yin approach to case study research.

3.3 Multiple Case Study Design

A case study approach focuses on collecting information about a specific object, event or activity. In case studies the case is the individual, the group, the organization, the event or the situation the researcher is interested in. Yin (1994) identifies four types of case study designs shown in Figure 1.

	Single Case design	Multiple case design
Holistic (single unit analysis)	One critical case with analysis of one single case	Multiple cases with analysis of one single unit within each case
Embedded (Multiple unit analysis)	One critical case with analysis of multiple units within single case	Multiple cases with analysis of multiple units within each case

Figure 1. Types of case study designs based on Robert Yin's 2x2 matrix. Adapted from (Yin, 1994, p. 39).

A multiple case study design is considered more robust compared to a single case case-study design. Analysis of multiple cases presents more compelling evidence. The researcher can expect predictable results from each individual case in the research. The tendency for different case studies to produce similar results is called replication logic (Yin, 1994; 2003). Replication

logic in case study is similar to replication logic as used in experiments. For multiple case study replication to occur, each case selected must “(a) predict similar results (a literal replication), (b) produce contrasting results but for predictable reasons (a theoretical replication)” (Yin, 1994, p. 46).

Figure 2 shows the replication logic approach to multiple case studies. Phase one consists of theory development and selecting cases. In phase one the researcher identifies a criterion for case selection measures to ensure proper data collection techniques (Yin, 2003). In phase two the researcher collects data and conducts individual case analysis. The researcher writes individual case reports. Phase three involves identifying similarities between all the individual cases. When applied correctly, each case should produce information that can be replicated in other cases (Yin, 2003). The author then prepares a cross case report. Sometimes, a case study research is conducted with the objective of using the information obtaining in policy formulation. This study does not involve policy implication and therefore the two steps enclosed in a red box were not applied to the study.

The researcher uses the COSMOS Corporation case study research method (Yin, 2003) to develop a seven-step methodology shown in Figure 3. The first phase of the COSMOS Corporation method is defining and designing the case study. This study uses a descriptive approach, therefore the first step on the COSMOS method, developing theory, is not applied to this study. The cases are selected from a pool of 44 airports that have received FAA Airport Sustainability grant as of December 1st, 2018. Six airports that fall under the classification of small hub airports in the NPIAS 2019-2023 report are the subject of this study. The researcher follows the Yin (2003) case study protocol for data collection. Phase two of the COSMOS Corporation method involves preparing, collecting and analyzing individual cases. These steps are shown as step 2 to step 6 on Figure 3. Individual case analysis and reports are provided in the Appendix Cases One to Six. The third phase on the COSMOS Corporation involves analyzing and drawing conclusions. These steps are shown as step 7 on Figure 3. Chapter 6 of this study provides a summary of the cross-case discussion and conclusions from the study. Two steps of phase three on the COSOS Corporation method; modify theory and develop policy implications are not applied in the study of the small hub airports.

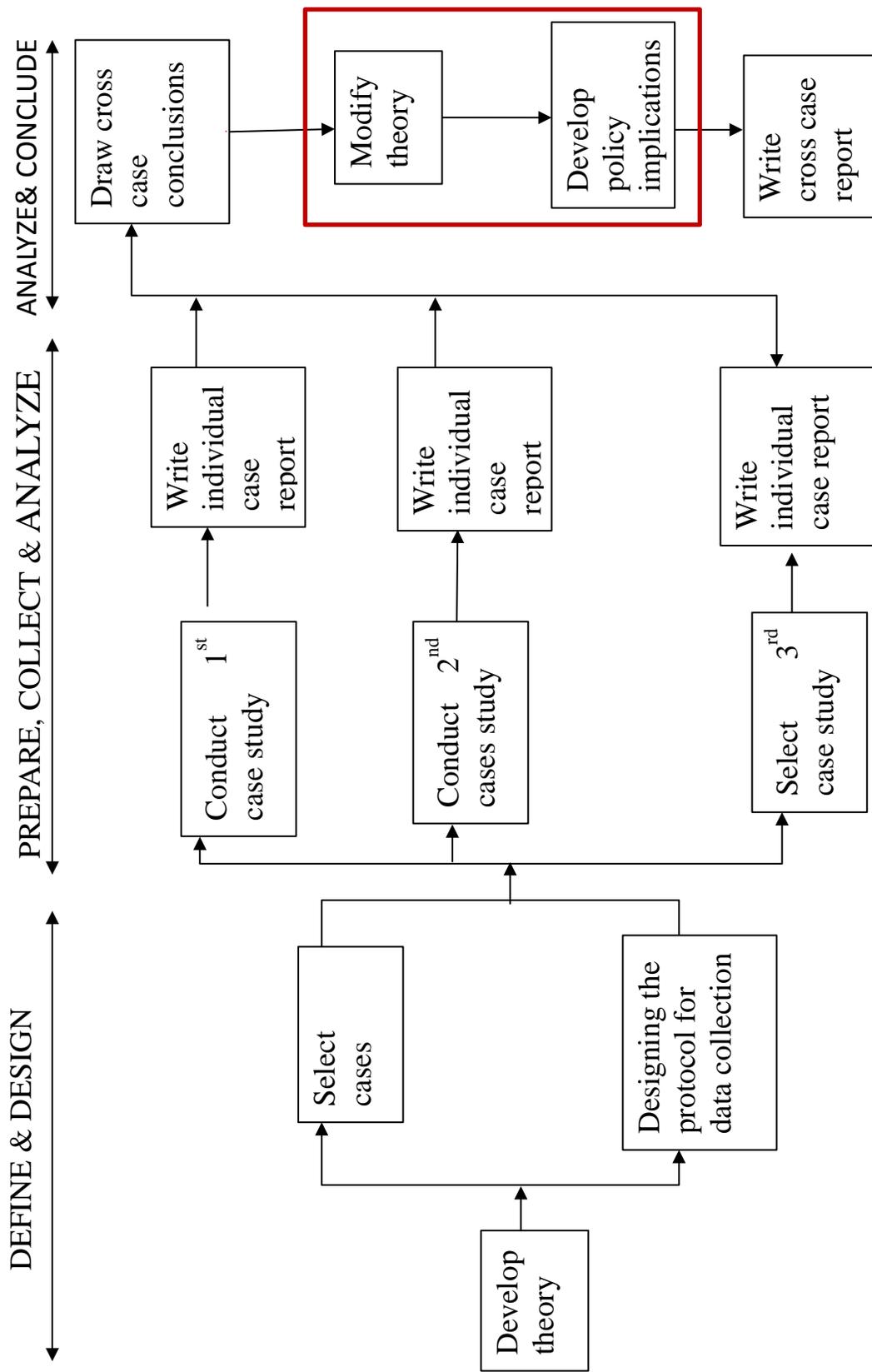


Figure 2. Case study method of COSMOS Corporation. Adapted from (Yin, 1994, p. 49).

A good case study uses multiple sources of evidence, also known as data triangulation (Yin, 2002). Table 4 shows the sources of evidence used in this study.

Table 4. Sources of Evidence

Source of Evidence	Strength	Weaknesses
Documentation	Unobtrusive - not created as a result of the case study Exact - contains exact details of an event Broad coverage –range of sources Stable - can be reviewed repeatedly	Retrieving data may take time Biased selectivity, if collection is incomplete Reporting bias reflects unknown bias of author Access may be limited
Archival records	(In addition to the ones above) Preciseness	(In addition to the ones above) Accessibility due to privacy
Company websites	Immediate access Readily available Remote Access.	Limited access Author Biased Biased for company image

Note. Sources of evidence. Adapted from (Yin, 1994, p. 80).

Multiple case study design with a single unit of analysis is used to conduct the study of the six small hub airports. Documents were retrieved from multiple sources including the organizations websites and annual reports. The use of multiple document sources helps to improve the validity of the study. The study reliability is enhanced by following a case study protocol in designing and conducting the research (Yin, 1994; 2003). The study is guided by the Yin approach to case study research.

3.4 Data Sources

The primary data source for this study is the sustainability planning documents prepared by the airport management and leadership teams. The primary documents for sustainability planning include sustainability airport master plans or sustainability management plan and communication documents. Sustainability planning documents are available to the public through the airports' websites. Links to the sustainability master plans and sustainability management plans are also available through the FAA Airport Sustainability website. Where data is available, the researcher reviewed documents from different years between the years 2010 to 2018. Supplementary documents such as airport memos and website content are used to improve the validity of the study.

3.5 Unit of Analysis

The selected unit of analysis is based on correctly defined research questions (Yin, 1994). Based on the research questions formulated, the researcher decided that sustainability planning is the unit of analysis for this study.

3.6 Method of Research Analysis

Once data has been collected, the researcher must make data presentable and draw conclusions to answer research questions. In some instances, the useful information drawn from the data analysis process becomes a basis for decision making. Yin (2003) proposes five ways of analyzing data from case studies “pattern matching, explanation building, time series analysis, logic modelling and cross case synthesis” (Yin, 2003, p. 109). The first four techniques can be applied to both single case and multiple case design. The cross-case technique is used exclusively for multiple case study design. In order to produce a high-quality analysis while attending to all the evidence collected the researcher uses a cross case analysis technique proposed by Yin to analyze the data from the six cases. The analyses follow a general descriptive strategy.

Each case study has information in these sections:

- I. Airport background, vision and mission statements;
- II. Definition of sustainability as used in sustainability planning documents;
- III. Existing sustainability initiatives;
- IV. Sustainability categories focus areas;
- V. Recommended sustainability initiatives included in the sustainability plan;
- VI. Monitoring and tracking system used to track sustainability initiatives.

Figure 3 shows seven steps developed by the researcher to aid in the research process. Steps one and two involve collecting data and identifying the definitions of sustainability used by the six small hub airports. Where an explicit definition of sustainability is not provided, the researcher identified key term and phrases used in the documents to come up with a definition of sustainability. The key terms and phrases identified in step two were combined with information obtained in step three: identifying the sustainability categories focus areas, to construct an affinity diagram. To construct an affinity diagram, the researcher identified key words and phrases that

were used in the six airports sustainability planning documents most frequently. After a careful analysis the groups of key words and phrases were placed in six groups: energy, water management, finance/economic, waste management and recycling, environmental conservation and social/community/people. The choice of the six groups is guided by Janic (2010) definition of airport sustainability, “sustainability implies simultaneous increasing of the overall social-economic benefits and increasing at a slower rate, stagnating, and/or diminishing of the negative impacts of these airports during the specified medium to long-term period of time” (Janic, 2010, p. 206). Based on this definition and careful assessment, the researcher considered the six groups as most reflecting the idea of an airport that provides increasing benefit and decreasing the negative impacts. Using the six groups the researcher constructed two affinity diagrams, one based on the sustainability categories focus areas identified from the airport planning documents and a second affinity diagram to identify groups of sustainability initiatives included in the airport planning documents.

In step four of the research process, the information obtained from the affinity diagram was used to show a comparison of the similarities and differences in the six airport approaches to sustainability planning.

Step five, the researcher identified examples of sustainability initiatives from each airport. Examples of initiatives was considered a valuable piece of information for use by other airports that would like to use this study as a guide for incorporating sustainability planning in their airport plans. Unlike sustainability categories which provide a focus area, the initiatives provide specific actions and metrics used in a sustainability project. A list of sustainability initiatives at each airport is included in each case report in the Appendix.

In steps six and seven, the researcher prepared individual case reports included in the Appendix and concludes by drawing cross case conclusions.

Step 1. Collect data. Retrieve sustainability planning documents for the six airports: sustainability master plan/ sustainability management plans, website content related to sustainability, annual reports and other relevant documents for the period 2010-2018.

Step 2. Identify similar concepts, and descriptive words used to describe sustainable projects in the six airports. Formulate a definition of sustainability based on the information presented.

Step 3. Identify sustainable projects categories focus areas used in the documents such as: environmental concerns, natural resources preservation, economic viability and community engagement.

Step 4. Analyze the sustainable projects categories identified to find similarities and differences in the six airport plans.

Step 5. Identify and describe specific sustainability initiatives undertaken by the six airports.

Step 6. Prepare the case study reports for each of the six airports.

Step 7. Draw cross case conclusions and prepare a cross case report.

Figure 3. Seven steps of the research process developed by the researcher based on the COSMOS Corporation multiple case study replication method.

3.7 Researcher Interference

The researcher is an avid aviation professional with a background in aviation and aerospace management. This research is carried out with the awareness that the researcher may be biased due to prior knowledge of the aviation industry. A researcher in airport sustainability reviews the results of the study to reduce researcher bias.

3.8 Conclusion

This chapter addresses the study methodology used to answer the research questions. The researcher presents a review of the multiple case study research design. A detailed step by step study methodology is provided. The data sources and the method of research analysis are also discussed in detail. The researcher emphasizes the techniques applied to improve study validity.

CHAPTER 4. DATA

This chapter presents the data collected from the six small hub airports in the study. The data used in this study was collected between December 1, 2018 and March 28, 2019. The data collected include background information on the airport, definition of sustainability used by the airport, the current sustainability initiatives at the airport, sustainability categories focus areas and the sustainability initiatives included in the airport plans. Table 5 shows the sources of data used in the study.

4.1 Airport Background Information

Although the airport statistics are not a subject of this study, where available, the researcher included a section on airport background, vision and mission statements to give context to the size and level of operations at each of the six small hub airports. Figure 4 shows basic airport information extracted from Form 5010s Airport Master Records and Reports (AirportIQ™ 5010) as of December 1, 2018.

4.2 Definitions of Sustainability

Studies have shown that the air transport industry lacks a standard definition of sustainability (Martin-Nagle, 2015; Landrum & Brown, Inc. et al., 2012). The researcher reviewed the documents available from each airport and identified a definition of sustainability as used in the sustainability planning documents. Where a clear definition was not provided, the researcher identified descriptive words and concepts used in the planning document to come up with a definition of sustainability. Figure 5 shows the definitions of sustainability as used in the sustainability planning documents for each of the six small hub airports.

4.3 Sustainability Project Categories Focus Areas

Sustainability projects are designed to meet goals and objectives in specific priority areas of airport design and operations. The triple bottom line (TBL) which incorporate economic, environment and social dimensions of sustainability is one of the most widely adopted models for sustainability planning (Janic, 2010). Another model, the EONS model incorporates economic, operations, natural resources and social dimensions of sustainability and is mostly used by larger airports around the world. The researcher identifies key descriptive words and concepts used to describe sustainability focus areas for each of the six small hub airports. The focus areas were grouped into

six categories that are considered priority areas in sustainability planning. Figure 6 shows sustainability focus areas for each airport grouped into six priority areas.

Once the sustainability focus areas are identified, the researcher identified sustainability initiatives in each of the six sustainability priority areas. Sustainability focus areas provide a generalized category of sustainability projects. Sustainability initiatives provide measurable actions and metrics for each focus area. Table 6 shows examples of sustainability initiatives from each of the six airports. A list of sustainability initiatives is included in each case analysis in the Appendix, Cases One to Six.

Table 5. Sources of Sustainability Data

Airport	Documents used
Akron-Canton Regional Airport (CAK). Akron, Ohio	<ul style="list-style-type: none"> • Integrated sustainable master plan (CAK, 2015). • Airport sustainability website (CAK, 2019). • Airport Facebook feeds (CAK, 2019). • Airport YouTube channel (CAK, 2019).
Dayton International Airport (DAY). Dayton, Ohio	<ul style="list-style-type: none"> • Integrated sustainable master plan (DAY, 2017). • Airport sustainability website (DAY, 2019). • Airport Contractor Facebook feeds (Passero Associates, 2019).
Fresno Yosemite International Airport (FAT). Fresno, California	<ul style="list-style-type: none"> • Stand-alone sustainability management plan (City of Fresno, 2012). • Airport sustainability website (FAT, 2019).
Huntsville International Airport (HSV). Huntsville, Alabama	<ul style="list-style-type: none"> • Stand-alone sustainability management plan (HSV, 2017). • Airport sustainability website (HSV, 2019). • Airport Facebook feeds (HSV, 2019). • Airport YouTube channel (HSV, 2019).
Portland International Jetport (PWM). Portland, Maine	<ul style="list-style-type: none"> • Integrated sustainable master plan (PWM, 2016). • Airport sustainability website (PWM, 2019). • Airport Facebook feeds (PWM, 2013).
Northwest Arkansas Regional Airport (XNA). Springdale, Arkansas	<ul style="list-style-type: none"> • Integrated sustainable master plan (Email communication with Ryan Hannan). • Airport sustainability website (XNA, 2019). • Airport Facebook feeds (XNA, 2019).

Note. Sources of data used for each of the six airports.

<u>Airport Name</u>	<u>ICAO Code</u>	<u>Location</u>	<u>Ownership</u>	<u>Use</u>	<u>Annual Operations</u>	<u>No. of Based Aircraft</u>
Portland International Jetport	PWM	Portland, Maine	Public	Public	50,800	40
Dayton International Airport	DAY	Dayton, Ohio	Public	Public	50,552	31
Huntsville International Airport	HSV	Huntsville, Alabama	Public	Public	63,015	80
Akron Canton Regional Airport	CAK	Akron, Ohio	Public	Public	67,509	136
Fresno Yosemite International	FAT	Fresno, California	Public	Public	99,559	142
Northwest Arkansas Regional Airport.	XNA	Fayetteville/Springdale, Arkansas	Public	Public	41,567	8

Figure 4. General airport data as of December 1, 2018. Adapted from (AirportIQ®, 2018).

<p>Akron-Canton Regional Airport Authority (CAK)</p> <p>“promoting social progress; enhancing the customer experience; protecting and conserving natural resources; reducing the Airport’s carbon footprint; increasing efficiency and reducing operational and maintenance costs; and promoting local and regional economic growth” (CAK, 2015, p. 7-42).</p>
<p>Dayton International Airport (DAY)</p> <p>“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.” (DAY, 2017, p. 3).</p>
<p>Fresno-Yosemite International airport (FAT)</p> <p>“Sustainable development balances economic development and environmental stewardship with innovative business enterprises that focus on the ‘triple bottom line’ of providing economic, environmental and social benefits” (City of Fresno, 2012, p. 1-1).</p>
<p>Huntsville International Airport (HSV)</p> <p>“Sustainability is setting priorities and taking actions to enhance sustainability of an airport while continuing to offer safe and efficient air transportation to the citizens and businesses and the community around the airport” (HSV, 2017, p. iii).</p>
<p>Northwest Arkansas Regional Airport (XNA)</p> <p>“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.” (XNA, 2018, p. E3).</p>
<p>Portland International Jetport (PWM)</p> <p>“A broad term that encompasses a wide variety of practices applicable to the management of airports.” (PWM, 2016, p. 3).</p>

Figure 5. Definitions of sustainability as used in airport sustainability documents.

	Akron Canton Regional Airport	Dayton International Airport	Fresno Yosemite International Airport	Huntsville Int'l Airport Carl T Jones Field	Northwest Arkansas Regional Airport	Portland International Jetport
Energy related categories	<ul style="list-style-type: none"> • Energy Management 	<ul style="list-style-type: none"> • Energy 	<ul style="list-style-type: none"> • Energy 	<ul style="list-style-type: none"> • Energy Efficiency • Renewable Energy and Emissions Reduction 	<ul style="list-style-type: none"> • Energy Consumption / Greenhouse gases 	<ul style="list-style-type: none"> • Operational Efficiency
Water related categories	<ul style="list-style-type: none"> • Water Resource Management 	<ul style="list-style-type: none"> • Stewards of the Environment 	<ul style="list-style-type: none"> • Water Quality • Water Conservation 	<ul style="list-style-type: none"> • Water Efficiency 	<ul style="list-style-type: none"> • Water Quality 	<ul style="list-style-type: none"> • Natural Resource Conservation
Finance/Economic related categories	<ul style="list-style-type: none"> • Economic Vitality 	<ul style="list-style-type: none"> • Sustainable Investment • Resiliency 		<ul style="list-style-type: none"> • Supporting Communities 	<ul style="list-style-type: none"> • Airport Finance • Operations and Maintenance of Airport 	<ul style="list-style-type: none"> • Economic Viability
Waste Management and Recycling related categories	<ul style="list-style-type: none"> • Solid Waste & Recycling 		<ul style="list-style-type: none"> • Indoor Environmental Quality • Hazardous Materials • Solid Waste and Recycling 	<ul style="list-style-type: none"> • Waste Reduction 	<ul style="list-style-type: none"> • Waste Management and Recycling 	
Environmental conservation and Natural Resource related categories	<ul style="list-style-type: none"> • Administration • Green Construction 		<ul style="list-style-type: none"> • Surface Transportation • Landscape Management • Sustainable Site and Land Use Compatibility 		<ul style="list-style-type: none"> • Natural Habitats • Air Quality • Construction Management 	
Social/Community/People related categories	<ul style="list-style-type: none"> • Air Quality 	<ul style="list-style-type: none"> • People 	<ul style="list-style-type: none"> • Social Economic and Community Outreach 		<ul style="list-style-type: none"> • Community Relations and Education 	

Figure 6. Sustainability priority areas found in sustainability documents grouped into six areas identified by the researcher.

Table 6. Examples of Adopted Sustainability Initiatives at the Small Hub Airports

<u>Airport</u>	<u>Sustainability Initiatives</u>
Akron-Canton Regional Airport, Ohio	<ul style="list-style-type: none"> • Terminal building Renovation. Example, construction of a covered outdoor area for outbound baggage makeup. • Expansion of the South side of the Y² concourse gates.
Dayton International Airport, Ohio	<ul style="list-style-type: none"> • Organize a “Green Team” at the Airport. • Reduce Paper Waste and increasing use of E-documents. • Retrofit and /or replace existing light Fixtures with LED ones. • Planting native warm season grass. • Increase use of biodiesel or other alternative fuels within the airport. • Increase local sourcing. • Develop an airport microgrid.
Fresno Yosemite International Airport, California	<ul style="list-style-type: none"> • Installation of photovoltaics. • Promote use of alternative fuel and electric vehicles. • Improve metrics for measuring GHG emission.
Huntsville International Airport, Alabama	<p><i>Note.</i> Researcher did not find a list of sustainability initiatives for Huntsville International Airport. The HSV Sustainable Master Plan identifies a list of actions for each sustainability focus area. Each action is matched to a metric. Based on the researcher assessment, the action and their matching metrics may be interpreted as sustainability initiatives. No timelines for achieving the actions were found.</p>
Northwest Arkansas Regional Airport, Arkansas	<ul style="list-style-type: none"> • Building a parking garage for better customer experience and generate revenue for the airport. • Consider use of renewable energy. • Occupancy sensors. • New air traffic control tower.
Portland International Jetport, Maine	<p><i>Note.</i> The researcher did not find a list sustainability initiative for the Portland International Jetport. PWM Sustainability Master Plan identifies a list of actions in each sustainability focus area. Each action is matched to a target. No timelines for achieving the actions were found.</p>

Note 1. Examples of sustainability initiatives at the small hub airports.

Note 2. Concourse Y refers to one of the concourse gates at the Akron-Canton Regional Airport

4.4 Summary

This section summarizes the data collected from sustainability documents for the six small hub airports in the study. The data include the definitions of sustainability found in the sustainability documents, a list of the sustainability categories focus areas and the sustainability initiatives included in the airport sustainability planning documents. The data presented in this chapter is used to answer the two research questions and draw conclusions on the study in the subsequent chapters.

CHAPTER 5. RESULTS

This chapter presents the findings of the study on the approach to sustainability planning used by six small hub airports in the United States. Using the research methodology outlined in chapter three, the researcher reviewed publicly available sustainability planning documents, website content and social media feed related to sustainability planning for the six small hub airports in the study. Five of the six airports had their Sustainable Master Plan or Sustainability Management Plan documents publicly available through the airport websites. To obtain the Northwest Arkansas Regional Airport (XNA) document, the researcher contacted the airport manager and received the document on email. The study follows a seven-step process outlined in Figure 3 in chapter three of this document. The seven steps were developed based on the COSMOS Corporation case study multiple replication logic methodology (Yin, 2003). The researcher reviewed the documents four times, the first time to gain an overview of the content of the documents. The second review included highlighting the sustainability focus areas and relating to the research questions. The third review included a more robust analysis, note taking and developing an affinity diagram for sustainability categories focus areas and the sustainability initiatives. The researcher completed a fourth review to cross check the information extracted from the documents and making certain it was correctly presented in the individual case studies. Multiple replication logic (Yin, 2003) is used to prepare individual case reports. The six case study reports are attached as Appendix of this document. Each case report contains this information:

- I. Airport background, vision and mission statements;
- II. Definition of sustainability as used in sustainability planning documents;
- III. Existing sustainability initiatives;
- IV. Sustainability categories focus areas;
- V. Recommended sustainability initiatives included in the sustainability plan;
- VI. Monitoring and tracking system used to track sustainability initiatives.

The researcher did not find an established theory development strategy on the topic of airport sustainability. Based on the (Yin, 2003) approach to use of case study research, a descriptive theory approach is most appropriate for case studies when there is no established theory

development strategy (Yin, 2003). The researcher used data from different sources of data or data triangulation, to improve the validity of the study (Yin, 2003).

The six airports use sustainable master plans or sustainability management plans as the official documents on sustainability planning. The researcher reviews other documents provided on the airport website such as news releases and social media feeds. Based on the researcher assessment, social media is mostly used by airports to communicate to the public, communities around the airport and travelling customers.

5.1 Research Question 1

RQ1: What are the definitions of airport sustainability used by each of the six small hub airports? Elliott Black, then acting director, Office of Airport Planning and Programming at FAA identified airport sustainability as “a broad term that encompasses a wide variety of practices applicable to planning, design, and building and operation airport facilities” (Black, 2010. Para. 2). In the memo addressing the newly launched Airport Sustainable Master Plan Pilot Program, Black (2010) outlines the three core principles of airport sustainability as “(a) protecting the environment; (b) maintaining high and stable levels of economic growth; and (c) social progress that recognizes all stakeholders’ needs.” (Black, 2010, p. 1).

Research question 1 was answered after collecting and reviewing the documents available on the topic of sustainability from each airport. Figure 5 shows that two airports, Dayton International Airport (DAY) (See Appendix. Case Two) and Northwest Arkansas Regional Airport (XNA) (See Appendix. Case Five) have adopted the definition of sustainability consistent with the ACI-NA definition of sustainability. ACI-NA defines sustainability 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.” (DAY, 2014, p. 3; XNA, 2018, p. E3).

Where an explicit definition of sustainability was not provided, the researcher uses descriptive words and concepts used in the sustainability planning documents to come up with a suitable definition of sustainability. The researcher arrives at the following descriptions of sustainability for Huntsville International Airport (HSV) (See Appendix. Case Four) “sustainability is setting priorities and taking actions to enhance sustainability of an airport while continuing to offer safe and efficient air transportation to the citizens and businesses and the community around the airport” (HSV, 2017, p. iii).

The Portland International Jetport (PWM) (See Appendix. Case Six) adopted a tailored definition of sustainability, one that considers its unique operating conditions. The Portland International Jetport (PWM) definition of sustainability is an amalgamation of definitions of sustainability from various aviation organizations. According to the PWM Sustainability Master Plan, *ACRP Synthesis 10: Project 11-03, Topic S02 – 02* provided the guidelines for definition of airport sustainability at the Jetport, that is, “a broad term that encompasses a wide variety of practices applicable to the management of airports” (PWM, 2016, p. 3). The Airport Sustainability Master Plan further emphasized the importance of maintaining the key elements of the triple bottom line, that is, economic, environmental and social benefits of an airport business (PWM, 2016, p. 3).

Fresno Yosemite International Airport (FAT) (See Appendix. Case Two) Sustainability Management Plan is part of the City of Fresno Sustainability Plan. The Fresno Yosemite International Airport (FAT)’s definition of sustainability is incorporated in the City of Fresno’s definition of sustainability defined as “sustainable development balances economic development and environmental stewardship with innovative business enterprises that focus on the ‘triple bottom line’ of providing economic, environmental and social benefits” (City of Fresno, 2012, p. 1-1).

The Akron Canton Regional Airport Authority (CAK) (See Appendix. Case One) defines airport sustainability as “promoting social progress; enhancing the customer experience; protecting and conserving natural resources; reducing the Airport’s carbon footprint; increasing efficiency and reducing operational and maintenance costs; and promoting local and regional economic growth” (CAK, 2015, p. 7-42). The CAK definition includes an aspect of customer experience which is omitted in the other five small hub airports.

5.2 Research Question 2

RQ2: What are the approaches to sustainability planning adopted by the small hub airports?

Before an airport can report on sustainability, it must first include sustainability in its planning. This study focuses on the approaches to sustainability planning for small hub airports. The six airports in this study are among the 44 airports that have received FAA Airport Sustainability Planning grant to prepare comprehensive documents on Airport Sustainability Planning. The FAA guidelines for the Airport Sustainability Planning required airports to prepare sustainability

planning documents as an integrated Masterplan or as an independent document to supplement the traditional master plan. Figure 7 shows the document type prepared by each airport.

<u>Sustainable Master Plan (within masterplan)</u>	<u>Sustainability Management Plan (Standalone)</u>
<ul style="list-style-type: none"> • Akron-Canton Regional Airport (CAK) • Portland International Jetport (PWM) • James M. Cox Dayton International Airport (DAY) • Northwest Arkansas Regional Airport (XNA) 	<ul style="list-style-type: none"> • Huntsville International Airport (HSV) • Fresno Yosemite International Airport (FAT)

Figure 7. Type of sustainability documents prepared by the six airports.

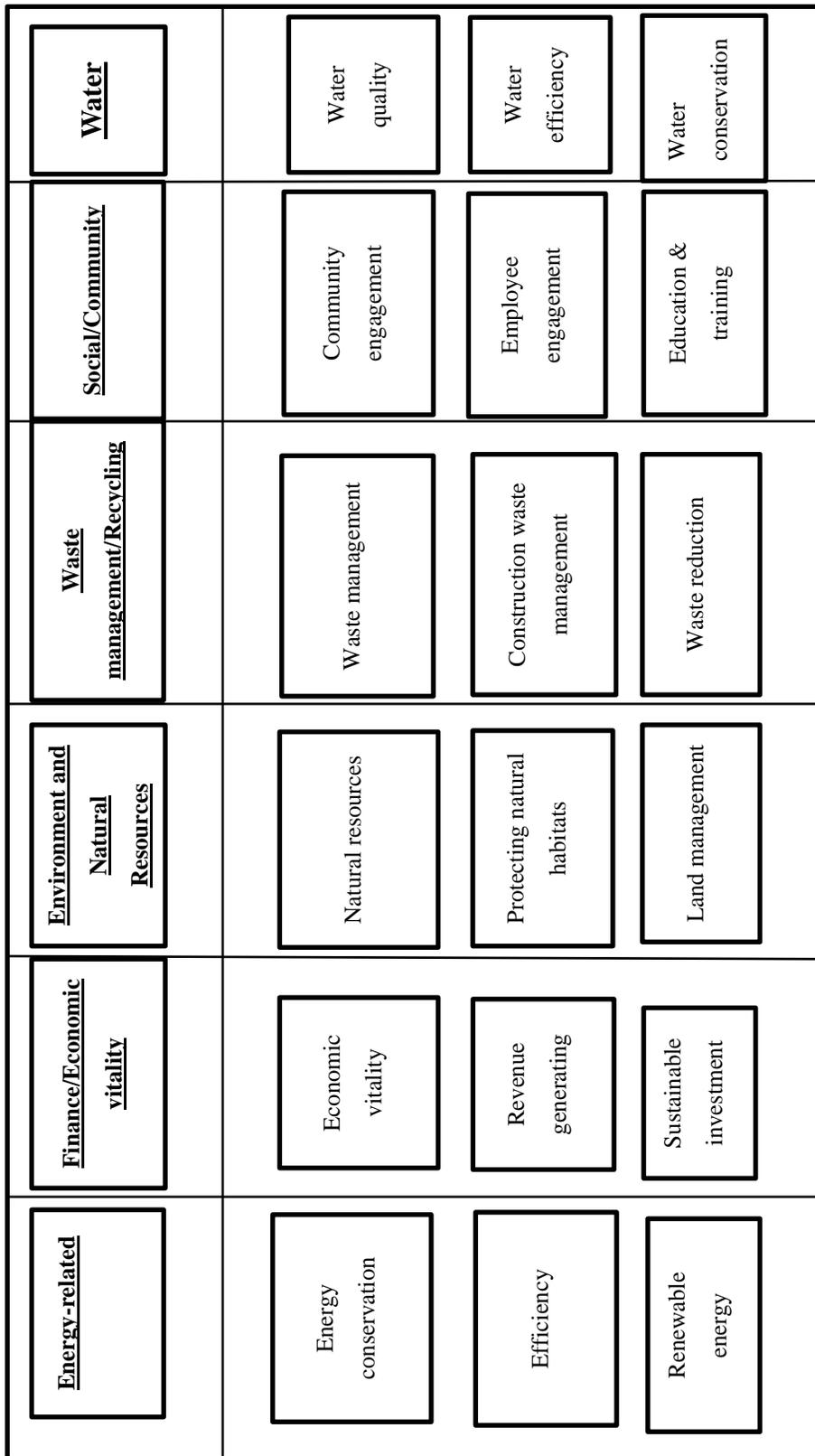
A sustainable master plan is recommended for airport managers who are in the process of updating the traditional master plan (Black, 2010). A standalone document or a Sustainable Management Plan is recommended for airport managers who are not updating their master plan but consider sustainability a priority issue worth pursuing (Black, 2010).

Figure 7 shows that two airports in the study: Huntsville International Airport (HSV) and Fresno Yosemite International Airport (FAT) prepared standalone sustainability management plans. Four airports, Akron-Canton Regional Airport (CAK), Dayton International Airport (DAY), Northwest Arkansas Regional Airport (XNA) and Portland International Jetport (PWM) incorporated sustainability within the airport sustainable master plans. Akron-Canton Airport (CAK) incorporated a chapter on the topic of sustainability management within the airport master plan although it is implied that the airport used an integrated sustainability master plan.

The Northwest Arkansas Regional Airport (XNA) categorized the focus areas into primary and secondary categories (See Appendix. Case Five). Primary categories are the initial focus areas and secondary categories are categories that the airport finds important and may become an additional area of focus in the future as the airport grows.

Huntsville International Airports (HSV) (See Appendix. Case Three) is the only small hub airport in the study that indicated the use of data from Sustainable Aviation Guidance Alliance (SAGA) database, an open source database where airports share their experiences in implementing sustainability initiatives was reviewed as part of the preparation for the sustainability management plan. HSV also indicated that materials from peer airports was reviewed before embarking on the sustainability journey.

In identifying the approaches to sustainability planning used by the small hub airports, the researcher created an affinity tree to identify similar concepts and key descriptive words used in the sustainability planning documents. The affinity tree identified sustainability projects by categories such as energy, environment/natural resources conservation, finance/economic vitality/airport operations, waste management/recycling and social/people/community engagement. Figure 8 shows the affinity tree created by the researcher to show sustainability topic areas identified by the researcher matched to descriptive words found in the sustainability planning documents. Figure 6 shows a list of the sustainability categories focus areas identified from the sustainability documents arranged by topic areas. Figure 9 shows the sustainability categories focus areas organized to show the representation of the EONS model (economic, operations, natural resources and social). Figure 10 shows the sustainability categories focus areas organized to show the representation of the Triple Bottom Line dimensions (economic, environment and social).



Sustainability priority areas

Examples of common sustainability

Figure 8. An affinity diagram showing sustainability priority areas developed by researcher.

	Economic Viability	Operations	Natural Resources	Social
Akron- Canton Regional Airports	<ul style="list-style-type: none"> • Economic vitality • Green construction 	<ul style="list-style-type: none"> • Administration • Solid waste and recycling • Energy management 	<ul style="list-style-type: none"> • Water resource management • Air quality • Green construction • Solid waste and recycling 	<ul style="list-style-type: none"> • Air quality
Dayton International Airport	<ul style="list-style-type: none"> • Resiliency • Sustainable investment 	<ul style="list-style-type: none"> • Energy 	<ul style="list-style-type: none"> • Stewards of the environment 	<ul style="list-style-type: none"> • People
Fresno Yosemite regionals Airport		<ul style="list-style-type: none"> • Energy • Solid waste recycling 	<ul style="list-style-type: none"> • Energy • Water conservation • Water quality • Land management • Solid waste recycling • Hazardous materials • Sustainable site and land use compatibility 	<ul style="list-style-type: none"> • Hazardous materials • Surface transportation • Social economic and community outreach • Indoor environmental quality
Huntsville International Airport		<ul style="list-style-type: none"> • Energy efficiency • Renewable energy and emissions reduction • Waste reduction 	<ul style="list-style-type: none"> • Renewable energy and emissions Reduction • Waste reduction 	<ul style="list-style-type: none"> • Supporting communities
Northwest Arkansas Regional Airport	<ul style="list-style-type: none"> • Airport finance 	<ul style="list-style-type: none"> • Energy consumption/Green house gases • Operations and maintenance of airport • Construction management 	<ul style="list-style-type: none"> • Waste management and recycling • Construction management • Natural habitats • Air quality 	<ul style="list-style-type: none"> • Water quality • Community relations and education • Air quality
Portland International Jetport	<ul style="list-style-type: none"> • Economic viability 	<ul style="list-style-type: none"> • Operational efficiency 	<ul style="list-style-type: none"> • Natural resource conservation 	

Figure 9. Sustainability categories organized to show representation of the EONS model.

	Economic	Environmental	Social	Unclassified
Akron-Canton Regional Airports	<ul style="list-style-type: none"> • Economic vitality • Green construction 	<ul style="list-style-type: none"> • Water resource management • Air quality • Green construction • Solid waste and recycling • Energy management 	<ul style="list-style-type: none"> • Air quality • Water resource management 	<ul style="list-style-type: none"> • Administration
Dayton International Airport	<ul style="list-style-type: none"> • Resiliency • Sustainable investment 	<ul style="list-style-type: none"> • Stewards of the environment • Energy 	<ul style="list-style-type: none"> • People 	
Fresno Yosemite regionals Airport		<ul style="list-style-type: none"> • Energy • Water conservation • Water quality • Land management • Solid waste recycling • Hazardous materials • Sustainable site and land use compatibility 	<ul style="list-style-type: none"> • Hazardous materials • Surface transportation • Social economic and community outreach • Indoor environmental quality 	
Huntsville International Airport		<ul style="list-style-type: none"> • Renewable energy and emissions Reduction • Waste reduction • Energy efficiency 	<ul style="list-style-type: none"> • Supporting communities 	
Northwest Arkansas Regional Airport	<ul style="list-style-type: none"> • Airport finance 	<ul style="list-style-type: none"> • Waste management and recycling • Construction management • Natural habitats • Air quality • Energy consumption / Greenhouse gases 	<ul style="list-style-type: none"> • Water quality • Community relations and education • Air quality 	<ul style="list-style-type: none"> • Operations and maintenance of airport • Construction management
Portland International Jetport	<ul style="list-style-type: none"> • Economic viability 	<ul style="list-style-type: none"> • Natural resource conservation 		<ul style="list-style-type: none"> • Operational efficiency

Figure 10. Sustainability categories organized to show representation of the TBL model.

5.3 Research Question 2(a)

RQ2 (a): What are the similarities and differences in the approach to sustainability planning?

The similarities and differences in the approach to sustainability planning for small hub airports are drawn from the affinity diagram shown in Figure 8. Frameworks were examining the commonalities in the categories identified in the affinity diagram. Table 7 shows a summary of the similarities and differences based on the researcher conclusions on the affinity diagram, the representation of the TBL model and the EONS model of sustainability.

Table 7. A Comparison of the Similarities and Differences in the Approaches to Sustainability

Similarities	Differences
<ul style="list-style-type: none"> • The cost of project implementation is a top priority for small hub airport managers. • Energy related projects are considered easier to implement and most require low capital investment. • Stakeholder involvement is considered key to the successful implementation of the sustainability plan. • There is more awareness on the environmental dimension of sustainability in comparison to other dimension. • The benefits of sustainability planning are considered long term. • Sustainability champions are an important component of sustainability planning and implementation. 	<ul style="list-style-type: none"> • Selection of sustainability projects is guided by the unique needs of each airport. No standardized strategy was found common to all airports. • The resources used in the preparation of sustainability plans varied depending on the focus areas. For instance, although the SAGA database is recommended and used by most large airports, only one of the small hub airports used the resources provide by SAGA. • The classifications used to categorize projects is not standard. For instance, energy projects may be classified under environmental conservation and airport operations.

Note. Similarities and differences were identified through an in-depth analysis by the researcher. Information from the two affinity diagrams was used together with the analysis based on the comparison with the EONS and TBL models.

5.4 Research Question 2(b)

RQ2 (b): What sustainability initiatives have been undertaken by the small hub airports?

The sustainability planning documents reviewed for each airport addressed a list of sustainability initiatives that the airport plans to undertake to incorporate suitability in the operations of the airport. Over 150 sustainability initiatives are identified from four of the six airports. Two airports – Huntsville International airport (HSV) and Portland International Jetport (PWM) - did not provide a list of initiatives. The researcher used descriptive words used in the planning documents to identify sustainability initiatives incorporated in the master plan. A list of sustainability initiatives for each airport is included in the Appendix Cases One to Six. The researcher used an affinity diagram in Figure 11 to identify examples of some of the most common sustainability initiatives among the six airports. The affinity diagram was created using descriptive words and concepts used to describe sustainability initiatives in the sustainability documents.

The most adopted sustainability initiatives can be classified under the energy-related sustainability focus area. Based on the EONS and TBL sustainability models, energy-related projects may be classified under the economic, environmental or operations categories of sustainability. Energy-related initiatives such as installing motion sensors to minimizing the use of electricity in the buildings and using LED light bulbs require minimal capital investment and are easier to adopt compared to other projects (Prather, 2016; Martin-Nagle & Klauber, 2015). After a careful analysis of the energy-related sustainability initiatives among the six small hub airports, it is the opinion of the researcher that energy-related initiatives present the highest benefits at the lowest investment cost for small hub airports. For instance, electricity bill is one of the highest operation costs for small hub airports; an energy related initiative results to reduction in cost of electricity. Simultaneously, most energy saving projects are considered to have a lower environmental impact. By investing in an energy-related initiative, an airport can save cost and be compliant with environmental impact regulations.

Waste management and recycling initiatives are also widely adopted among the six airports. Examples of sustainability initiatives in this area include initiatives to minimize land fill waste and initiatives to increase recycling awareness for the airport and its tenants. The Northwest Arkansas Regional Airport (XNA) included construction waste management in the list of waste management and recycling initiatives. One may conclude that managing airport waste will likely improve the efficiency of the airport operations and save the airport the cost of commercial waste

disposal services. Initiatives in this category require minimal capital investment. Although construction waste management is only considered in one airport out of the six airports in the study, this should be a consideration for other airports as they plan to expand airports with additional buildings. In the EONS sustainability framework, waste management may be classified as either operations or natural resources. In the TBL framework, waste management and recycling initiatives are classified as environmental related sustainability initiatives. The increasing number of environmentalists and the general public awareness on the effects of synthetic materials to the environment may have contributed to the high number of waste management and recycling initiatives. All six airports had existing water quality or water management initiatives prior to preparing the updated airport master plans. On water related initiatives, the researcher concludes that the existence of water related regulations in most cities around the world is the reason the water related initiatives have been adopted in all six airports. A list of existing and planned sustainability initiatives found for each of the six airports is included in each individual case in the Appendix.

5.5 Summary

This chapter highlighted the results of the study on incorporating sustainability planning in airport master plans. The researcher showed the definitions of sustainability, the approaches to sustainability planning and the list of sustainability initiatives. The representation and use of the TBL and EONS model of sustainability is shown.

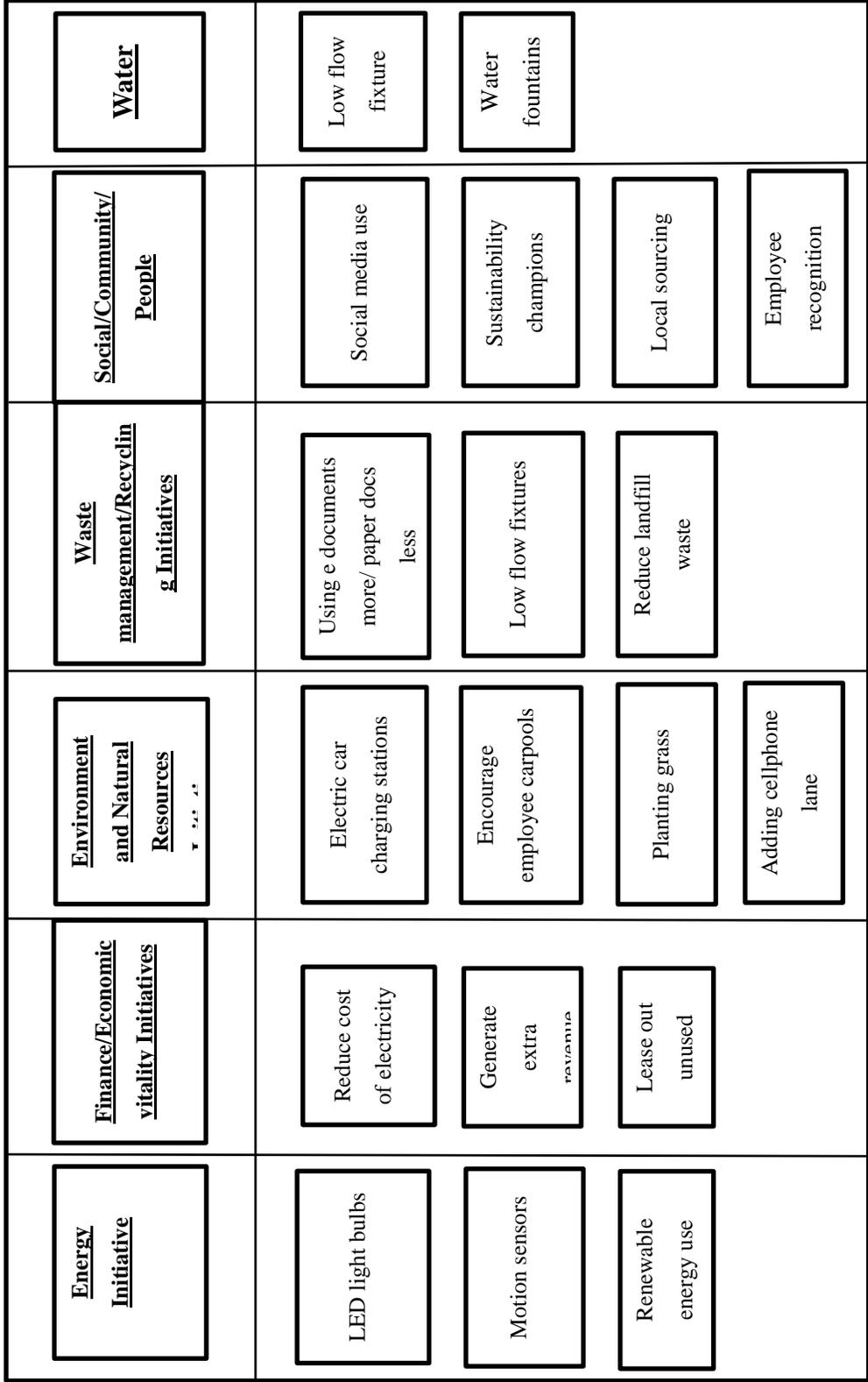


Figure 11. An affinity diagram showing sustainability initiatives by priority areas developed by researcher.

CHAPTER 6. DISCUSSION, RECOMMENDATIONS AND CONCLUSION

This chapter presents a synthesis of the study results provided in chapter 4. The discussion provides a list of the main categories identified during the document review process for the six airport sustainability programs. The researcher attempts to identify the approach to sustainability planning used by the small hub airports. Following the main categories identified, the sustainability initiatives are identified. All six airports followed the FAA Airport Improvement Program (AIP)-Airport Sustainability content requirements for master plan or sustainability management plan.

The adoption of sustainability planning is a relatively new concept in many industries. The *Brundtland Report* presented to the UN General Assembly by the World Commission on Environment in 1987 was the first initiative into considering the effects of businesses on the environment. Since the 1987, much of the world has embraced sustainability in great measures. The adoption of sustainability in the air transport industry has been championed by several leading organizations including ICAO, IATA, ACI International, ATAG, FAA and EASA. States through the aviation regulating organizations are encouraging aviation companies to incorporate sustainability in their operations. The Federal Aviation Administration has included in its Airport Improvement Program a program on Airport Sustainability. To date 44 US airports of all categories have benefited from the FAA Airport Sustainability AIP grant. The six small hub airports in the FAA Airport Sustainability Program are the subject of this study.

Despite the adoption of sustainability principles, there is still no one globally accepted way of incorporating sustainability initiatives in airport planning. The consensus among industry experts is that each airport operates under unique conditions and therefore each airport should prepare a tailor-made sustainability plan. This approach presents the challenge in that the lack of standardization does not allow airport managers to compare their approach to other airports. Attempts by the ACI-NA has been made to provide guidelines for incorporating sustainability in airport master plans. ACI-NA has adopted the *Brundtland Report* definition of sustainability that include economic, social and environmental aspects, with the addition of the operations sustainability known as the EONS model.

The EONS model provides guidelines for airports interested in including sustainability in their master plans. ACI-NA has also championed the efforts by airports in North America to share experiences with adoption of sustainability through the SAGA database, a platform where airports

can share their experiences in adopting sustainability projects. This study has attempted to identify some of the approaches that six small hub airports adopted in incorporating sustainability in their master plans.

6.1 Discussion

In incorporating sustainability to their master planning process, the six small hub airports took different approaches. The FAA pilot program guidelines were used by all six airports. The focus areas selected by each airport presented an indication of what the airport considers priority areas. Reducing the amount of energy consumed at the airport is a common priority area for all the six airports. Statements such as, “The Port paid particular attention to opportunities to reduce the use and cost of energy” (HSV, 2017) are used repeatedly to emphasize the focus areas for each airport. GHG emission is another area that was considered a priority area. All six airports have initiatives to reduce the effect on environment by putting measures that reduce the emission of GHG.

Only one of the airports, Huntsville International Airport (HSV), indicated the use of online resources such as Sustainable Aviation Guidance Alliance database in the sustainability planning process. According to the HSV Sustainability Management Plan, before embarking on the selection of focus areas, HSV collected ‘best practices’ data from the industry and in the areas around the airport, resources such as the Sustainable Aviation Guidance Alliance’s database, an open source database where airports can share their experiences in various sustainability activities. HSV also identified 30 peer airports and reviewed publicly available sustainability initiatives at those sites. In addition to airport data, HSV reviewed sustainability practices within the top 10 employers in the Huntsville region to identify possible synergies and partnerships with the Port of Huntsville.

Stakeholder involvement which is considered a critical part in the process of sustainable airport management planning was widely adopted. The main stakeholder involved included the airport staff, airport tenants, communities around the airport and airport business partners.

In December 2012, FAA published a report, *A Report on the Sustainable Master Plan Pilot Program and Lessons Learned*, on the airport sustainability planning pilot program started in 2009 (FAA, 2012). Based on the pilot program lessons learned, staff involvement from the start and involving the local community in decision making are some of the characteristics of the most successful sustainability plans (FAA, 2012). Airports involved in the pilot program report significant benefits which led the AIP to continue the Airport Sustainability Program.

The findings of the study of the six small hub airports on the categories of sustainability initiatives adopted is very similar to the results presented by the FAA report on lessons learned from the sustainability pilot study (FAA, 2012). A few variations include the “airport connectivity” reported in the FAA pilot study but is missing in the study of small hub airports (FAA, 2012). One explanation for this different may be because the larger airports included in the pilot study require a higher level of connectivity compared to small hub airport in this study. Passengers transiting through large airports are mostly in long haul flights and are likely to want connectivity, on the other hand, small hub airports have shorter transit time and connectivity may not be a priority for passengers.

Another variation between the FAA pilot study and the findings from the small hub airports study is that small hub airports emphasized more on the economic vitality or financial benefits in selecting sustainability projects. Small hub airports operate on smaller budgets and must make the most of every improvement opportunity. For small hub airports, reaping a financial benefit is a higher priority when selecting sustainability initiatives to implement.

Additionally, the FAA pilot study report argues that airports that integrated airport sustainability throughout the planning documents were more effective than ones that devote a chapter on sustainability (FAA, 2012). On the other hand, the findings from the study on the six small hub airports show that all the airports devoted a significant amount of resources to incorporating sustainability in their plans. Although the argument presented in the pilot program report may appear logical, one might argue that the results on the effectiveness of the proposed initiatives are difficult to quantify at this point. The preparation of airport master plan is a long-term process. Considering that most of the airports only completed the process of sustainability planning in the last five years, it will take a few more years before the results can be judged as either effective or ineffective.

6.2 Recommendations for Future Research

While this research has provided insight to the sustainability planning approaches adopted by small hub airports, there are myriad questions that remain unanswered on airport sustainability. A study of the effectiveness of the planned sustainability initiatives would benefit airport managers in planning for future initiatives. Adoption of a sustainability reporting framework such as the GRI Standards may be used to provide a universally acceptable reporting framework on the impact of the implemented initiatives. Based on the argument presented by various airport managers on the

lack of financial resources, the researcher recommends exploring further the economic benefits reported after incorporating a sustainability management plan or a sustainable master plan. An analysis on the long-term economic benefits of adopting sustainability in airport planning would be of benefit in conducting a cost/benefit analysis and deciding on project priorities. A study on the attitudes of employee towards sustainability planning adopting additionally, the benefits observed by communities around airports that adopt sustainability initiatives would be a good indicator of the organization/community relationship.

6.3 Conclusion

Studies on airport sustainability are scarce (Prather, 2015). More so, for research on sustainability for small hub airports. The impact of larger airports to the communities and the environment have received more attention by researchers (Landrum & Brown, Inc. et al., 2012; Prather, 2016; Martin-Nagle & Klauber, 2015). One of the biggest challenges in incorporating sustainability in small hub airport planning is a lack of financial and skills resources. FAA, ACI global, ATAG, IATA among aviation industry stakeholders have put effort to highlight the benefits of sustainability planning in airports of all sizes globally.

This research focused on the efforts of six US small hub airports in incorporating sustainability in their airport master plans. The six airports received the FAA Airport Sustainability AIP grants enabling them to prepare comprehensive airport sustainability master plans. The six airports are located in different regions of the United States. The objective of the study is to prepare an in-depth analysis highlighting the approaches to sustainability used by the six airports in their sustainability master plans. This qualitative analysis enabled the researcher to draw a comparison on the similarities and differences in the approaches used by the six airports. This study is important because there no one standardized system of incorporating sustainability in airport master plans for small hub airports. The findings of this research may be used by other airports of the same size in different regions of the United States and at a global level to prepare sustainability planning documents.

The finding of this study indicate that airport managers are interested in incorporating sustainability in their airport master plan. However, small hub airports face the challenge of lack of finances and skilled labor to support planning and implementation of sustainability projects. The six airports in this study were funded by the FAA Airport Sustainability AIP grant. Based on the data gathered from the six airports, the FAA grant made possible for the airports to hire

suitability consultants and procure other resources to support the suitability project at their airports. Based on the qualitative analysis conducted by the researcher, it was evident that the financial resources are a major hindrance to promoting airport sustainability. Consequently, even with the FAA grant small hub airports seemed avoid high investment project that would require a high maintenance cost once the FAA grant is depleted. For instance, the Northwest Arkansas Regional Airport (XNA) Master Plan includes primary and secondary goals. The primary goals are considered easier to maintain. The secondary goals were included in case the airport findings additional funding to support their implementation in the future.

For the FAA Airport Sustainability grant, FAA provided a set of guidelines for what is to be include in the airport sustainability master plan. This is because there is no one accepted way of incorporating sustainability in airport master plans. Airports interested in including sustainability in their master plans are required to adopt a strategy that best suits their specific airport operations. The six airports in this study produced varying documents based on different airport operations. This study found that using resources such as SAGA *Sustainable Aviation Resource Guide* may be beneficial in providing a standardized system to planning and reporting sustainability for small hub airports. However, the SAGA guide cannot be used as is, the guide must be adjusted to match the small hub airport operations.

Because of the variations in the ways the six documents were prepared, two airports – HSV and FAT prepared standalone airport master plans while four airports – CAK, PWM, DAY and XNA incorporated sustainability in the traditional master plan. The study also showed that airports focused of different areas of sustainability. Environmental and social sustainability projects were most adopted among the six airports. The researcher concludes that the choice of project was guided by ease of implementation and the resources required to maintain the project in the long run. Environmental projects are considered to have the most attention globally and are likely to be funded. For instance, projects aimed at minimizing energy consumption and emission of GHG. Most social sustainability projects require minimal financial investment and present the highest return for the airport. For instance, supporting the local community through local sourcing and providing employment to local people.

A comparison of the similarities and differences with popular sustainability models like the EONS and TBL showed that the six airports adopted the definitions of sustainability based on the popular sustainability models. Two airports – DAY and XNA used the definitions of

sustainability as used by ACI-NA. The other four airports developed definitions of sustainability based on their primary sustainability focus areas. Most sustainability focus areas in the six airports could be in both the EONS and the TBL. Where there are variations, it was likely because of use of different words. The GRI Standards, commonly used by large airport for sustainability planning were not used by any of the six airports. The researcher concluded this might have resulted because GRI Standards are considered highly comprehensive and acquisition of sustainability consultants familiar with the use of GRI Standards is expensive.

To conclude, this study sought to provide an in-depth qualitative analysis on the approaches to airport sustainability for small hub airports in the United States. Although the efforts to incorporate sustainability in airport planning are increasing for airports of all sizes, studies on small hub airports were still lacking. This study addressed sustainability planning in small hub airports. Given that small hub airports handle 8% of US traffic, industry stakeholders need to increase efforts to support sustainability planning in small hub airports.

APPENDIX

Note. Unless otherwise noted, texts used to prepare individual case analysis is based on the individual airport sustainability master plan or sustainability management plan documents.

Case One: Akron-Canton Regional Airport (CAK), Ohio

I. Airport Background, Vision and Mission Statements

Opened in October 1946, the Akron-Canton Regional Airport is located in Northeast Ohio, between Akron and Canton cities (Akron-Canton Regional Airport, Airport Master Plan, 2015). The airport covers 2,400 acres of land in the City of Green and partially extends southwards into Jackson Township (CAK, 2015). The Airport supports commercial airline services, air cargo, military and general aviation (CAK, 2019). The Airport employees include Airport President, Chief Executive Officer and 49 airport workers. CAK operations supports over 3,100 local jobs and contributes about \$500 million to the local economy (CAK, 2015). The Airport had a total of 921,000 enplanements in 2012 and continues to experience a steady growth (CAK, 2015).

Sustainable Management Plan. The Akron-Canton Regional Airport prepared a Sustainable Management Plan an additional companion document to the traditional airport Master Plan. According to the CAK Master Plan, “The Sustainable Management Plan incorporates the principles of sustainability into the everyday operation and long-term planning of the airport” (CAK, 2015, p. 7-42). CAK has also conducted a part 150, Noise Compatibility planning study as part of the airport master plan update (CAK, 2015).

CAK Vision and Mission Statements

The vision of CAK focuses on enhancing the customer experience at the airport. Convenience, easy access and good amenities are key to the CAK vision. It states that “the long-term vision for CAK is predicated on remaining the low fare airport of choice in northeast Ohio” (CAK, 2015, p. 1-10).

II. Definition of Sustainability as Used in Sustainability Planning Documents

The key elements in the Airport’s definition of sustainability involve, “promoting social progress; enhancing the customer experience; protecting and conserving natural resources; reducing the Airport’s carbon footprint; increasing efficiency and reducing operational and maintenance costs; and promoting local and regional economic growth” (CAK, 2015, p. 742).

III. Existing Sustainability Initiatives at CAK

The Airport had some sustainability initiatives that were put in place by the airport management before participating in the FAA Airport Sustainability program. Some of the initiatives included in the master plan are shown in Table A1.

Table A1. Some of the Existing Sustainability Initiatives at CAK

1. Aircraft deicing pads;
2. Anaerobic fluidized bed reactor technology;
3. Waste recycling;
4. Low flow fixtures and automatic toilets in the bathrooms;
5. Improved indoor lighting with fritted glass in terminal building;
6. Terrazzo flooring to replace carpet;
7. Improved access to the airport by public transport and additional cellphone lot;
8. Installation of LED fixtures
9. Participation in Part 150 Noise Compatibility Program; and
10. Storm water management plan (CAK, 2015).

IV. Sustainability Categories Focus Areas

The Akron-Canton Regional Airport Master Plan majorly focuses on the environmental and social dimensions of sustainability (CAK, 2015). The CAK Sustainability Management Plan identified eight focus areas (CAK, 2015).

1. Administration – The objective of this focus areas is to integrate sustainable practices in the day to day operations of the airport, now and in the long term. Additionally, this area will use measure to improve employee wellbeing by providing training and improved health plans;
2. Energy – Increasing energy use efficiency and reducing consumption;

3. Water – Reduced water usage at the airport, providing clean water and managing effectively storm water to maximize water conservation around the airport;
4. Air quality – Reduction of GHG emissions and compliance with National Environmental Policy Act (NEPA);
5. Green Construction – Sustainable construction and designs in future projects;
6. Solid Waste and Recycling – Aim to reduce amount of waste generated at the airport. Proper handling and storage of hazardous materials;
7. Community – Partnering with local government and communities, increase community outreach; and
8. Economic – Diversify services offered by the airport, finding ways of generating revenue for the airport and partnering with business communities (CAK, 2015).

V. Recommended Sustainability Initiatives Included in the Sustainability Plan

The CAK Airport Master Plan includes a chapter on Sustainable Management Plan. The researcher did not find this chapter comprehensive enough to cover all eight areas identified as the CAK sustainability focus areas. The Airport Master Plan states that “the Plan will establish mechanisms for incorporating environmentally friendly technologies, practices and procedures into daily activities and long-term facility planning” (CAK, 2015, p. 7-45). After reviewing the master plan, the researcher identified some projects for future implementation focused mainly on customer service and improving the regional economy (CAK, 2015). The decision for the choice of project is guided by the existing airport deficiencies and the forecasted growth. The planned projects include:

1. Renovation of the old terminal building;
2. Construction of additional gates to accommodate increasing airport traffic;
3. Reconfiguring airport access road;
4. Construction of additional parking garage; and
5. Improve the sewer system (CAK, 2015).

VI. Monitoring and Evaluation System Used to Track Sustainability Initiatives

The CAK master plan does not provide a monitoring and evaluation criteria for the sustainability initiatives.

Case Two: Dayton International Airport (DAY). Ohio

I. Airport Background, Vision and Mission Statements

Dayton international airport (DAY), is located in Montgomery County, Ohio, about nine miles from downtown Dayton (DAY, 2014). The Airport is owned by the City of Dayton and run by the City of Dayton, Department of Aviation. DAY is the third largest airport in Ohio with a total of 1,304,313 passenger enplanements and 57, 914 aircraft operations in 2012. DAY handled about 10,000 tons of cargo in 2012 (DAY, 2014). DAY employs 135 fulltime employees (DAY, 2019).

Sustainable Master Plan. DAY has an existing program for environmental sustainability for which it has won numerous prizes including the 2012 Dayton Regional Green 3 (DRG3) Green Business Certification awarded by Montgomery County for promoting green practices. In 2007, the City of Dayton adopted a Sustainable Practices Policy. The policy focuses on areas of sustainability such as; waste reduction, recycling, energy conservation, and environmentally friend procurement practices (DAY, 2014).

DAY Sustainability Mission Statement. “At the crossroads of innovation and sustainability, Dayton International Airport will strive to conserve our natural resources, operate efficiently, enhance our passenger experience, and serve as a vital asset to Southwest Ohio and beyond” (DAY, 2014, p.7).

II. Definition of Sustainability as Used in the Sustainability Planning Documents

DAY adopted a definition of sustainability consistent with the ACI-NA definition of Airport Sustainability, that is, “DAY is focused on a holistic approach to managing its airport to ensure economic viability, operational efficiency, natural resource conservation, and social responsibility (EONS)” (DAY, 2014, p. 3).

III. Existing Sustainability Initiatives at DAY

DAY sustainability team identified existing sustainability efforts for each of the five focus areas.

Some of the existing energy initiatives at DAY include:

1. Use of LEDs in the airfield;
2. Directly billing airlines for electricity consumed;
3. Use of a more efficient energy management system with estimated 10 to 15% better efficiency; and
4. Providing hot water more efficiently with tankless heaters with estimated \$15K savings per year in gas usage (DAY, 2014).

Some of the existing people initiatives at DAY include:

1. Improved access to the airport by public transport;
2. Providing clean drinking water at no cost;
3. Passenger appreciation day initiative;
4. Free internet access- WIFI;
5. Regular passenger satisfaction study; and
6. Promoting employee health and mental wellness (DAY, 2014).

Some of the existing environmental Stewardship initiatives include:

1. Preservation of wetlands and other natural resources - For instance, the Stream Bank Mitigation Projects. This project preserves the water quality around the airport;
2. Providing power for aircraft parked at the gate to avoid running aircraft engines;
3. A cellphone waiting lot with flight notifications to reduce idling cars;
4. Regular shuttle service between the terminal building and other remote locations to facilitate passenger convenience and reduces emissions;
5. Airport recycling program started in 2012; and
6. Reducing use of paper and increasing e-faxing and double-sided printing (DAY, 2014).

Some of the existing sustainable investment initiatives at DAY include:

1. Annual Air Camp –Hosted in collaboration with a local university, the camp is aimed at introducing students to aviation;
2. The annual Dayton Vectren Airshow. The airshow was started in 1979 as a celebration of Dayton’s Aviation heritage as home of the Wright Brothers; and

3. The airport has built relationships with local charities contributing regularly to their goal (DAY, 2014).

Some of the existing resiliency initiatives at DAY include:

1. Develop a more efficient energy source independent from the traditional power grid;
2. A partnership with the local university to support and put effort on climate change (DAY, 2014).

IV. Sustainability Categories Focus Areas

DAY prepared an integrated Sustainable Master Plan focusing on five areas:

1. People - DAY strives to improve passenger experience and promote healthy work habits for airport employees.
2. Resiliency - The airport aims to support the global objective of reducing business impacts to the environment;
3. Energy - The airport aims to increase energy efficiency and promote use of renewable energy;
4. Stewards of the environment - The airport strives to builds a good relationship with the community by preserving the surrounding natural resources and reducing its negative impacts to the environment; and
5. Sustainable investment - This goal focuses on responsible investment of airport resources to support regional economy (DAY, 2014).

V. Recommended Sustainability Initiatives Included in the Sustainability Plan

Table A 2. Recommended Sustainability Initiatives at DAY

Recommended sustainability initiatives included in the sustainability plan
1. Promote sustainability awareness among airport employees;
2. Increase recycling of airport waste;
3. Provide convenient power charging stations for passengers;
4. Proper use of airport land, for instance, planting native grass;
5. Conduct a Life Cycle Analysis before implementing new projects;
6. Install water heaters with better efficiency;
7. Utilize Guidelines & Specifications to Promote Asset Protection;
8. Promote use of alternative fuels at the airport;
9. Install occupancy sensors in building; and
10. Promote local sourcing (DAY, 2017).

VI. Monitoring and Tracking System Used to Track Sustainability Initiatives

Table A 3. Sustainability Monitoring and Tracking Tools at DAY

DAY Sustainability monitoring and tracking tools.
<ul style="list-style-type: none"> • Dayton International Airport Sustainability Playbook – provides detailed information on cost, technical details and description on implementation for each of the initiatives. DAY had a total of 25 short term initiatives; • Annual Sustainability Report Card. Uses an excel spreadsheet to show project performance and metrics (DAY, 2014).

Case Three: Fresno Yosemite International Airport (FAT), California

Note. The official ICAO code for Fresno Yosemite International Airport is FAT. However, the Fresno Yosemite International Airport Sustainability Management Plan indicates that the airport is commonly referred by the code FYI. FAT is used in this document in reference to the Fresno Yosemite International Airport.

I. Airport Background, Vision and Mission Statements

Fresno Yosemite International Airport (FAT) is located in Central California. The site of the airport was used by the US Army Air Force in the Second World War. In 1948, commercial air service began in FAT while the passenger terminal opened in 1962. FAT had a total of 121,644 aircraft operations in 2010 (Fresno Yosemite International Airport, 2019).

Fresno Yosemite International Airport Vision Statement: “Be the aviation industry leader in all that we do and be the premier choice for air travel” (City of Fresno, 2012, p. 1-1).

Fresno Yosemite International Airport Mission Statement: “Plan, develop, manage, and operate safe, sustainable, cost effective, and attractive aviation facilities; provide exceptional services; and promote the economic interests of the San Joaquin Valley” (City of Fresno, 2012, p. 1-1).

Sustainability Management Plan: The Fresno Yosemite International Airport Sustainability Management Plan is part of the City of Fresno “Green City” Plan. FAT has been a leader on environmental sustainability projects. For instance, FAT has the largest airport solar farm in the United States. The airport was part of the first ten airports that received the FAA Airport Sustainability Planning grant in 2010. FAT identified twelve areas of sustainability that are included in the Sustainability Management Plan focusing mainly on environmental sustainability. According to the FAT Sustainability Management Plan, environmental sustainability was considered the best use of airport resources (City of Fresno, 2012).

II. Definition of Sustainability as Used in the Sustainability Planning Documents

FAT's definition of sustainability is aligned with the 'green city' initiative of the City of Fresno. City of Fresno defines a green city as one that; "protects urban forests, promotes smart growth, buys locally, harnesses solar energy, provides bike and pedestrian trails, leads by example, rethinks, reduces, reuses, and recycles" (FAT, 2012, p. 1-2).

The Airport's definition of sustainability is aligned with its goal of balancing, economic, environmental stewardship and building an innovative airport business.

III. Existing Sustainable Initiatives

FAT has an established track record in championing sustainability issues. Notable is the Airport's solar farm. Some of the existing sustainability initiatives at the airport before the preparation of the FAT Sustainability Management Plan include:

Table A 4. Some of the Existing Sustainability Initiatives at FAT

Some of the Existing Sustainability Initiatives At FAT
1. Installation of new boilers with lower emissions and an estimated 30 percent annual savings in natural gas demand;
2. Improved storm water system with drain lines and drainage basin;
3. Loading bridges and cargo ramp that provide airlines with power to avoid running aircraft engines at the gate;
4. Renovation of the taxiways with recycled existing materials and installing LED lighting;
5. Using environmentally friendly cleaning materials within the airport;
6. Rental Car Facility for passenger convenience and consequently reduces GHG emissions;
7. Recycling program including recycling construction waste; and
8. Renovation of the terminal building and expansion of the baggage claim area (FAT, 2012).

IV. Sustainability Categories Focus Areas

The FAT Sustainability Management Plan identified twelve sustainability focus areas. Environmental sustainability initiatives were prioritized for being the best use of airport resources at the time planning. The sustainability focus areas are:

i. Air Emissions

According to the FAT baseline assessment study, aircraft operations contribute about 75 percent of the greenhouse gases at the FAT, while airport-controlled operations contribute about 2.19 percent of total emissions (FAT, 2012). The Airport's main objective is to reduce airport controlled and tenant-controlled emissions at the airport. FAT has set objectives and goals to reduce GHG emission at the airport. The air emission goals include:

1. Put measures to meet the local, national and global regulations on air emissions;
2. Converting airport vehicles to alternative fuels use and hybrid vehicles; and
3. Support airlines to use electric charging instead of running aircraft engines while at the gate (FAT, 2012).

ii. Energy

The main energy objective at FAT is to minimize energy consumption at the Airport. The other energy goals include:

1. Reduce electricity use at the airport. The Airport aims to save approximately \$25000 annually in electricity and natural gas use;
2. Increasing number of existing solar panels (FAT, 2012).

iii. Water Conservation

The main objective of the water conservation focus area is to reduce the amount of water consumed at the Airport. The goals include:

1. Installing low flow/high efficiency fixtures;
2. Reduced water usage in landscaping (FAT, 2012).

iv. Water Quality

Water quality focuses on storm water management around the airport. The Water quality goal will be achieved by:

1. Considering the environmental impact of a project before implementation. For instance, rain water harvesting and constructing porous pavements around the airport (FAT, 2012).

v. Noise

The Noise goals focuses on reducing the amount noise originating from the airport and causing disruption to the surrounding community. This goal is achieved by:

1. Participating in FAR Part 150 Noise Compatibility Program (FAT, 2012).

vi. Land Management

Land Management goal aims to maintain airport landscape to promote biodiversity. This goal is achieved through:

1. Reduce water usage and use of chemicals on airport land;
2. Consult local wildlife management office before planting any plant species on airport land;
3. Reduce water thirsty plantation on airport land; and
4. Add mulch to existing shrubs (FAT, 2012).

vii. Solid Waste and Recycling

The main goal of solid waste management and recycling is to reduce waste at the airport and promote recycling for airport and airport tenants. This will be achieved through:

1. Increasing recycling education for employees, tenants and passengers using posters and signage around the airport (FAT, 2012).

viii. Indoor Environmental Quality

The indoor environmental quality goal aims at promoting environmental stewardship and human health. This is achieved through:

1. Using low VOC products at the airport and for tenants' premises;
2. Incorporating sustainable designs in future airport constructions; and
3. Discouraging smoking around the airport buildings (FAT, 2012).

ix. Hazardous Materials

The Hazardous Materials focus area aims to ensure proper handling and storage of materials classified as hazardous. The materials such as: jet fuel, diesel, deicing fluids and other materials.

This goal is accomplished through:

1. Developing a tracking system for hazardous materials at the airport;
2. Minimizing number of spills when handling hazardous materials (FAT, 2012).

x. Surface Transportation

The goal of Surface Transportation is to reduce the movement of passenger and employee airports around the airport and therefore reduce the amount of GHG emissions. This goal will be achieved by:

1. Develop a program to encourage airport employees to carpool/rideshare and use alternative modes of transport other than driving.
2. Partnering with the local government in planning the city designs that minimize use of vehicles and support the airport's contribution to the local economy (FAT,2012).

xi. Social Economic and Community Outreach

The airport would like to continue to serve the community and involve locals and visitors in airport decision making. To achieve this goal, the airport plans to:

1. Produce regular newsletters, television ads and make the airport website interactive;
2. Increase displays around the airport to educate travelers on the airport's commitment to sustainability; and
3. Create an active social media presence (FAT, 2012).

xii. Land Use Compatibility

The goal is to implement projects that are aligned to the airport activities. For instance, avoid activities that attract wildlife that pose safe issues.

V. Recommended Sustainability Initiatives Included in Sustainability Management Plan

The FAT Sustainability Management Plan included 66 sustainability initiatives. An initiative may be included in more than one sustainability focus area. For instance, installing LED is both cost saving and reduces the energy used in the airport. Some of the sustainability initiatives in the Plan include:

Table A 5. Some of the Recommended Sustainability Initiatives at FAT

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1. Promote the use of hybrid and alternative fuel use vehicles around the airport;
 2. Pursue external funding sources such as FAA VALE (Voluntary Airport Low Emission) to support projects that reduce air emissions by the airport operations;
 3. Using the FAA requirements to continue airfield lighting upgrade to LED and other efficient technologies;
 4. Installing water conservation measures such as automatic sensor toilets and low flow fixture;
 5. Having airlines schedules flights to avoid excessive noise on takeoff and landing during peak hours;
 6. Minimize the amount of water used in irrigating plants by installing high efficiency irrigation systems;
 7. Review the ‘green purchase’ policy to ensure the airport is using environmentally and human friendly products;
 8. Involve technical experts in future sustainable construction projects at the airport;
 9. Train airport staff on storage and handling dangerous goods as they transit through the airport;
 10. Continuous surveys to airport employees, tenants, and passengers to determine their requirements when using the airport;
 11. Increasing sustainability awareness by using electronic message boards around the airport; and
 12. Continue partnering with the local community in determining best land use practices (FAT, 2012).
-

VI. Monitoring and Evaluation System Used to Track Sustainability Initiatives

Sustainability Report Card. The report card uses metrics to monitor project progress for each of the twelve sustainability goals.

Case Four: Huntsville International Airport -Cart T. Jones Airfield (HSV). Alabama

I. Airport Background, Vision and Mission Statements

Huntsville International Airport (HSV) is located in Madison County about 10 miles southwest of downtown Huntsville, Alabama. The Airport was constructed in 1967 as a jetport. It is currently the largest commercial airport in Northern Alabama. The Port of Huntsville owns and runs the Huntsville International Airport. The location of HSV is considered strategic for the regional economic development servicing over 1.2 million passengers per year (HSV, 2017).

Sustainability Management Plan. Huntsville International Airport (HSV) prepared a standalone Sustainability Management Plan. The HSV Sustainability Management Plan identified six priority areas that focus on sustainable development while maintaining a safe and efficient airport business to the benefit of the local community. Based on the description of the Plan, the airport focused on improving airport operations through cost saving, environmental sustainability and improving the community around the airport.

HSV Vision and Mission Statements. None found.

II. Definition of Sustainability as Used in the Sustainability Planning Documents

A definition of airport sustainability for HSV was not found. Based on the HSV Sustainability Management Plan, maintaining air transport safety and supporting the community are considered top priorities.

III. Existing Sustainability Initiatives

The HSV Sustainability Master Plan does not provide a clear list of the current sustainability initiatives. Two initiatives were identified:

1. Partnering with local charities, public educational programs and business partnerships;
2. Continuous training for airport employees (HSV, 2017).

IV. Sustainability Categories Focus Areas

Six focus areas were identified in the HSV sustainability planning documents: energy efficiency, renewable energy & emissions reductions, waste reduction, water efficiency, planning for the future, and supporting community. Improving energy efficiency and reducing the cost of energy use is a top priority for HSV.

i. Energy Efficiency

Improving energy efficiency at the airport and ultimately reducing the cost of energy use is on of the main sustainability focus areas for HSV. The Airport identified actions and metrics for improving energy efficiency. The goals and metrics for improving energy efficiency are:

1. Regular energy audit at the airport for airport and airport tenants;
2. The airport plans to identify and implement measurable energy initiatives;
3. Hiring professional energy management personnel to advice the airport on sustainability matters;
4. Upgrade the airport boiler system (HSV, 2017).

ii. Renewable Energy and Emissions Reduction

The renewable energy and emissions reduction goals focus on encouraging use of renewable energy for the airport and airport tenants. Use of renewable energy will ultimately result to lower GHG emissions. The airport will accomplish these goals by:

1. Consider using alternative energy source from traditional fossil fuels. For instance, a combined heat and power micro turbine system;
2. Include renewable energy options in future projects;
3. Track the GHG emissions by the airport and tenants (HSV, 2017).

iii. Waste Reduction

The aims at reducing the amount of waste generated by the airport and its tenants. This will be accomplished through:

1. Waste management audits,
2. The airport will develop a strategy for waste management and encourage its tenants to do the same;
3. Develop a composting program for landfill waste (HSV, 2017).

iv. Water Efficiency

The airport and its tenants use a significantly high amount of water. The Huntsville area where the airport is located has been known to droughts which affect airport operations. (HSV, 2017). The water efficiency initiatives are aimed at reducing the amount of water usage at the airport. Some of the goals set to accomplish this sustainability focus area include:

1. Conscious irrigation and landscaping plan;
2. Finding alternatives to traditional water sources. For instance, digging ground water wells (HSV, 2017).

v. Planning for the Future

In order to become sustainable now and in the future, the airport needs a well-trained man power. This goal is aimed at equipping employees with necessary skills for developing future airport leaders (HSV, 2017). The goal will be accomplished by:

1. A commitment to support employee wellness;
2. Develop a program for early career professionals;
3. Evaluate projects for cost vs benefits before implementation (HSV, 2017).

vi. Supporting Community

HSV considers partnerships with the local community a key aspect of airport operations. The airport aims to improve its relations with the community. HSV also plans to share lessons learned on the implementation of sustainable projects with the aviation community. Some of the goals the airport has set to meet this objective include:

1. Annual stakeholder meetings;
2. Being and active airport member of Airports Council -North America (ACI-NA).
3. Develop partnerships with local communities (HSV, 2017).

V. Recommended Sustainability Initiatives Included in the Sustainability Master Plan

The HSV Sustainability Management Plan does not provide initiative they plan to undertake in incorporating sustainability in the airport planning. The metrics provided for each action in the focus areas could be considered the future sustainability initiatives.

VI. Monitoring and Evaluation System Used to Track Sustainability Initiatives

Sustainability Champions. Huntsville International Airport identified a Sustainability champion for each of the Sustainability Management Plan focus areas. The sustainability champions are personnel identified through stakeholder involvement process to in support the implementation and monitoring of the specific sustainability initiatives.

Case Five: Northwest Arkansas Regional Airport (XNA), Arkansas

I. Airport Background, Vision and Mission Statements

The Northwest Arkansas Regional Airport (XNA) is located in Northwest Arkansas, Benton County, approximately 10 miles west of Rogers, Arkansas. The Airport was opened in December 1997 and currently provides services in general aviation, corporate business jets and commercial service passenger services. XNA had 44,000 total Aircraft operations and 541,000 passenger enplanements in 2012. The average annual passenger activity is expected to increase by in the next 20 year to approximately 870,000 in 2032 (XNA, 2018).

Sustainable Master Plan: Northwest Arkansas Regional Airport (XNA) prepared an integrated Sustainable Airport Master Plan. The XNA Airport Master Plan focuses more on environmental and social sustainability. The five main objectives of the Sustainable Master Plan are: “Provide a high standard for the safety and customer satisfaction; provide a high standard for operational efficiency; demonstrate environmental stewardship; provide a financially and socially beneficial resource to the community/region; and provide positive partnership with tenants, neighbors, regulators and other stakeholders” (XNA, 2018, p. E5).

Northwest Arkansas Regional Airport Mission Statement: “The Northwest Arkansas Regional Airport strives to provide an operationally safe and efficient airport that is financially sound, promotes economic growth in the region and enhances environmental sustainability and social responsibility” (XNA, 2018, p. E5).

II. Definition of Sustainability as Used in the Sustainability Planning Documents

Northwest Arkansas Regional Airport adopted a definition of sustainability consistent with the ACI-NA definition of sustainability. The ACI-NA definition of sustainability focuses on the economic, operation, natural resources and social (EONS) dimensions of sustainability.

III. Existing Sustainability Initiatives

Some of the sustainability initiatives identified as existing initiatives before the preparation of the updated airport master plan. These are:

1. Above average customer experience;
2. Surveys conducted every five years; and
3. Regular facilities and equipment inspection (XNA, 2018).

IV. Sustainability Categories Focus Areas

The XNA Sustainable Airport Master Plan identified primary and secondary focus areas. For each area, a set of goals and metrics are used to track sustainability. The focus areas are aligned with the airport mission and objectives. Primary focus areas will be implemented first, the secondary areas may be put on hold and will be implemented as funds become available. Some of the primary focus areas include:

i. Finance

Airport financing is an essential part to ensuring the continuity of airport operations in the long term. Some aspects of airport financing include funding day to day operations, maintenance cost and facilities upgrade. The main goal is to increase revenue generating activities at the airport. This will be accomplished by:

1. Putting measures to increase commercial aviation operations measured by the number of commercial operation and number of destinations from XNA;
2. Providing diversified revenue generating services at the airport measured by dollar value spent by passengers at the airport; and
3. Increasing employment opportunities for the local community around the Airport (XNA, 2018).

ii. Energy Consumption/ Greenhouse Gases

Reduction in energy consumption bring many benefits to the airport. Such benefits include better air quality, cost saving on energy, compliance with environmental regulations among others. XNA main energy objective is to minimize the amount of energy in kilo Watt hours consumed at the airport while maintaining high standard of operations. This goal will be achieved by:

1. Minimizing the GHG emissions from the airport and its tenants measured in tons/ year;
2. Improved efficiency by replacing the airport heating and cooling systems; and
3. Minimizing the amount of lighting used in the airport buildings (XNA, 2018).

iii. Operations and Maintenance

A considerable amount of airport resources is spent on ensuring efficiency in operations and maintaining airport facilities to support daily airport operations. Operational sustainability means including sustainable practices to the day to day management of the airport. Additionally, incorporating sustainability in the management decision making ensures that sustainability efforts are supported by top leaders in the organization. The main goal of this focus area is to ensure that XNA continues to provide safe and efficient airport operations. This goal will be accomplished through:

1. Regular maintenance checks on the airport facilities;
2. Include sustainability practices in future airport projects; and
3. Minimizing safety hazards such as wildlife hazards around the airport (XNA, 2018).

iv. Waste Management and Recycling

Proper waste management and recycling can save an airport costs related to waste disposal. The main goal of XNA is to reduce the amount of waste generated by the Airport (XNA, 2018). This goal will be accomplished through:

1. Increasing recycling measured by annual cost;
2. Considering sustainability principles in future airport construction projects (XNA, 2018).

Some of the secondary sustainability focus areas at XNA include:

i. Water Quality

Water quality management includes managing storm water run off from the airport. XNA has an existing water quality management program that meet the local and national water regulation standards. The main concern for the airport in water quality is to continue meeting the water quality standard. In the future, XNA has set goals for improving water quality. These include:

1. Better water efficiency in airport buildings (XNA, 2018).

ii. Other secondary goals

1. Promote sustainability issues among employees, tenants and the community;
2. Involve local community before implementing land use related projects (XNA, 2018).

V. Some of the recommended Sustainability Initiatives at XNA

The Northwest Arkansas Regional Airport Sustainable Master Plan identifies sustainability initiatives, specific measures or action that can be taken to achieve sustainability goals established. Initiatives were identified for the five primary sustainability categories and the four secondary categories. According to the Master Plan, all initiatives will be implemented. However, the resources available to the airport will determine the priority of implementation of the initiatives. Several initiatives are included in multiple categories because they meet the goals set out in many different categories.

Table A 6. Recommended Sustainability Initiatives at XNA

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1. Ensure continuous monitoring of sustainability initiatives and record financial returns on each project;
 2. Expansion of the onsite rental car facility to provide convenience for passengers and tenants. This will also generate revenue for the airport;
 3. Acquire resources to allow expansion of aviation and non-aviation services offered by the Airport;
 4. Installation of motion sensors in future walkways, building and escalator constructions;
 5. Take measures to conserve energy in the buildings. For instance, insulation and using LED fixtures;
 6. Consider using unutilized airport land for renewable energy projects. This will both generate revenue and save airport cost on energy;
 7. Monitor appliances useful life and consider using certified energy saving products in future projects;
 8. Use signage around airport to remind drivers to turn off vehicle engines as necessary;
 9. Take measures to reduce water heating cost;
 10. Construction of a new air traffic control tower to maintain the Airport's high safety standards;
 11. Continue improving taxiway and runway pavements to accommodate a range of aircraft safely; and
 12. Take measure to reduce maintenance cost at the Airport. For instance, replacing older appliances with more efficient and energy saving appliances (XNA, 2018).
-

VI. Monitoring and Evaluation System Used to Track Sustainability Initiatives

The Northwest Arkansas Regional Airport (XNA) used the Plan, Do, Check and Act (PDCA) process to implement, track and report the implementation of sustainability projects (XNA, 2018). The PDCA process was used together with two other sustainability tools developed by the Airport. The other tools are:

i. The return on Investment Tool

The ROI tool helps the airport to track the return based on financial investment and environmental impact (XNA, 2018).

ii. Sustainability Tool

This tool helps to track sustainability reporting on projects. The tool will be updated regularly as projects on the Airport Master Plan are being rolled out. The sustainability tool provides useful measures such as: providing visual data on the success of a project and tracking key project metrics. The tool will also provide a visual representation of a project performance over several years (XNA, 2018).

Case Six: Portland International Jetport (PWM), Maine

I. Airport Background, Vision and Mission Statements

Portland International Jetport (PWM) is located in Cumberland County, approximately three miles from downtown Portland (Portland International Jetport, Sustainability Master Plan, 2016). The jetport was initially privately owned by the Portland Airport Company. Today, the Jetport is owned and operated by the City of Portland (PWM, 2016). The Jetport is headed by an Airport Director and employs approximately 50 people. Portland International Jetport had a total of 843, 944 passenger enplanements in 2013 and 869, 710 enplanements in 2015. Total cargo shipped was 12,261 tons in 2013 and 12,910 tons in 2015 (PWM, 2016).

Sustainability Master Plan. Portland International Jetport (PWM) prepared an integrated Sustainable Airport Master Plan incorporating sustainability in the daily operations of the Jetport. The PWM Sustainable Master Plan prioritized improvements in the airfield – taxiways and runway improvements, and the landside - commercial passenger terminal building, automobile parking garage, commercial aircraft apron, deicing apron, commercial air cargo and general aviation areas. A Planning Advisory Committee (PAC) was involved in preparation of the master plan. PAC included representatives from Federal Aviation Administration (FAA), the Portland International Jetport administrative staff, the City of Portland, local community representatives, State representatives and airport tenants’ representatives (PWM, 2016).

PWM Vision Statement. “Be the Airport of Choice for Maine” (PWM, 2016).

PWM Mission Statement. “The Portland International Jetport commits to be a premier New England Airport. We will provide a convenient, safe, and environmentally conscious gateway that exceeds our travelers’ expectations while reflecting the essence of the Maine experience” (PWM, 2016, p. 3).

II. Definition of Sustainability as Used in the Sustainability Planning Documents

The Portland International Jetport defined sustainability based on the unique operations of the Jetport (PWM, 2016). The Jetport's definition of sustainability aims at maintaining the elements of the triple bottom line (TBL), that is, economic, environmental and social sustainability. In this sense, the Jetport seeks to incorporate sustainability in various practices of managing an airport business (PWM, 2016).

III. Existing Sustainability Initiatives

Table A7 shows some of the existing sustainability initiatives before the preparation of the new PWM Sustainable Airport Master Plan.

Table A7. Existing Sustainability Initiatives at PWM

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1. Upgrading of the terminal building to Gold certification of the Leadership in Energy and Environmental Design (LEED®). The upgrade maximized on reducing construction waste and increasing recycling of waste from construction. For instance, the excavated clay waste went into runway improvement;
 2. The Jetport installed a more efficient geothermal heating and cooling system. This will result to reduced GHG emissions;
 3. Providing electric power for aircraft at the gate. This will allow airlines to reduce use of aircraft engine power and result to reduced emissions;
 4. The state-of-the-art deicing fluid program at PWM. The Airport provides treatment for used deicing fluid for the airport and external users;
 5. Wildlife management program;
 6. An improved customer focused program that provides exemplary services to travelers; and
 7. Incentive program for employees who use high efficiency and low emission vehicles (PWM, 2016).
-

IV. Sustainability Categories Focus Areas

The Planning Advisory Committee at PWM identified six priority categories for the PWM Sustainable Airport Master Plan. The six areas were considered based on relevance to the Jetport and the areas that require improvement to enhance the overall performance of the Jetport. Other areas of improvement such as water quality and noise assessment were not included in the top priority because the jetport has existing programs in these areas that meet the state and national regulation requirements. The top six priority areas are:

i. Greenhouse Gas Emissions

The Jetport's goal is to lead the national climate change movement by reducing the GHG emissions from the airport and its tenants. This goal will be achieved through:

1. Efforts to provide preconditioned air for commercial aircraft at the airport gate;
2. Promoting use of alternative fuels around the airport;
3. Installation of electric car charging facilities at the airport; and
4. Annual GHS emission audit (PWM, 2016).

ii. Energy

The Jetport would like to eventually consider onsite renewable energy generation. Other energy related goals include:

1. Minimize energy consumption in airport buildings;
2. Using LED lighting in airport building and parking garage;
3. Explore the use of pilot-controlled lighting in the airfield; and
4. Conduct a feasibility analysis to determine use on onsite renewable energy source (PWM, 2016).

iii. Waste Management and Recycling

The Jetport has an existing waste management and recycling program. PWM aims to continue the good waste management practices at the Jetport. Other ways of improving the waste management program include:

1. Increase recycling and waste management campaigns among employees and passengers;
2. Expansion of the existing composting pilot program (PWM, 2016).

iv. Ground Access and Transportation.

The Jetport would like to improve access to the Jetport by public transport which will result to a better user experience for Jetport users. This goal will be achieved by:

1. Using surveys to obtain feedback from employees and airport users on their user experience;
2. Partnerships with local public transport companies to increase frequency of local buses to the airport (PWM, 2016).

v. Social Responsibility

The goal is to promote a healthy work-life balance for Jetport employees and increase support to the local communities. The Jetport will achieve this goal by:

1. Partnering with local communities in promoting sustainable development;
2. Displaying local artwork to promote the local businesses;
3. Regular employee surveys (PWM, 2016).

vi. Governance

The goal of governance as a sustainability focus area is to ensure sustainability issues are included in the overall management and decision making at the Jetport. This goal will be achieved by:

1. Conduct a feasibility analysis on capital projects to determine the use of sustainability practices and identify alternatives before implementation;
2. Include a sustainability clause in future contracts with tenants and other contractors; and
3. Conduct and make public annual sustainability audits on sustainability projects (PWM, 2016).

V. Recommended Sustainability Initiatives Included in the Sustainability Plan

The initiatives for each focus area are included under each of the six areas.

VI. Monitoring and Evaluation System Used to Track Sustainability Initiatives

Sustainability Action Evaluation Tool is an excel-based tool custom made to assess the feasibility of each sustainability initiative (PWM, 2016).

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