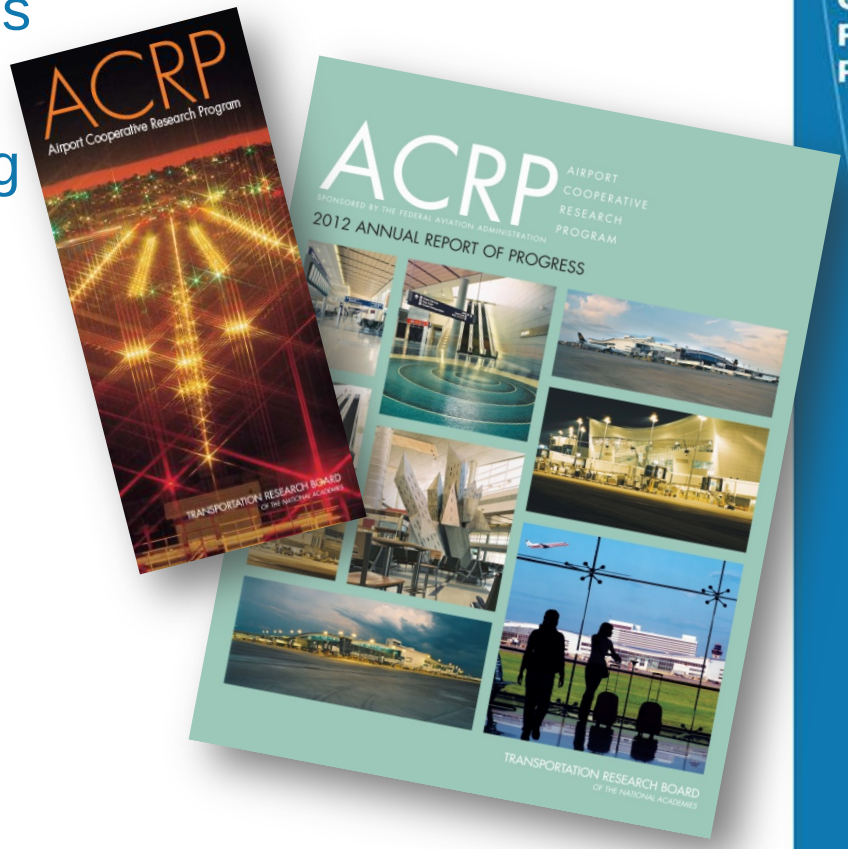
Information on ACRP

- www.TRB.org/ACRP
- Regular news and updates on:
  - Upcoming and ongoing research projects
  - New publications
  - Success stories
  - Announcements
  - Webinars
- Find ACRP on Facebook and LinkedIn



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Upcoming ACRP Webinars

- ***March 15 – Air Service Strategies for Small, Medium, and Non-Hub Airports in Today's Competitive Environment***
- ***March 17 – Identifying and Developing New Sources of Airport Revenue***
- ***April 6 – Effective Emergency Management Preparedness***

You can register for and learn more about upcoming 2016 webinars by visiting:

http://www.trb.org/ACRP/ACRPwebinars.aspx

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Opportunities to Get Involved!

- ACRP's Champion program is **a new initiative**!
- Designed to help early- to mid-career, young professionals grow and excel within the airport industry.
- Airport industry executives sponsor promising young professionals within their organizations to become ACRP Champions.
- Visit ACRP's website to learn more.

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Additional ACRP Publications Available on this Topic

- **ACRP Report 40 –** Airport Curbside and Terminal Area Roadway Operations
- **ACRP Report 110 –** Evaluating Impacts of Sustainability Practices on Airport Operations and Maintenance
- **ACRP Report 148 –** LED Airfield Lighting System Operation and Maintenance
- **ACRP Synthesis 49 –** Helping New Maintenance Hires Adapt to the Airport Operating Environment
- **ACRP Synthesis 63 –** Overview of Airport Fueling Operations

You can learn more about these publications by visiting ***www.trb.org/publications***

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Today's Speakers

Moderated by Chad Makovsky, City of Phoenix Aviation Department

1) Report 139: Optimizing Airport Building Operations and Maintenance Through Retrocommissioning: A Whole-Systems Approach
   - Peter Dahl, Ph.D., HGA Architects and Engineers

2) Report 92: Guidebook to Creating a Collaborative Environment Between Airport Operations and Maintenance
   - Mike Nichols, Amadeus Consulting
   - Steve Wareham, Trillion Aviation

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ACRP Report 139: Airport Building O&M Optimization and Retrocommissioning: A Whole-Systems Approach

Peter K. Dahl, Ph.D., LEED AP BD+C & O+M, CEM
HGA Architects & Engineers

Peter K. Dahl, Ph.D., LEED AP BD+C & O+M, CEM
Principal Investigator

- Director of Sustainable Operations, HGA Architects & Engineers
- Ph.D. in Architectural Engineering from Penn State
- Chair, USGBC-Minnesota Chapter
- Certified Energy Manager (CEM)

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ACRP Report 139 Oversight Panel

Peter Higgins, *Salt Lake City Department of Airports,* (Chair)
Isilay Civan, *HOK*
Richard Connolly, *Los Angeles World Airports*
Lorie Hinton, *Arapahoe County (CO) Public Airport Authority*
Tansu Sengezener, *Johnson Controls*
John A. Walewski, *Texas A&M University*
Kelly Slusarski, *FAA Liaison*
Richard Marchi, *ACI-North America Liaison*
Christine Gerencher, *TRB Liaison*

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ACRP Report 139: Retrocommissioning

- Documents best practices for a whole-building lifecycle approach to O&M optimization and retrocommissioning
  - Improve reliability
  - Control energy costs
  - Reduce emissions
- Provides guidance for preparing a building systems optimization and retrocommissioning plan
- Published February 2015

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Research Problem

Challenges for airport facilities

- Operating budget cuts
- Deferred maintenance
- Energy costs and associated emissions
- Facility reliability
- Customer experience

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Research Approach

O&M best practices:

- Staff training
- Preventive & Predictive maintenance programs
- Computerized Maintenance Management Systems
- Building Information Models (BIM)
- Energy Management Program
- Energy Audits
- **Retrocommissioning:**
  - Planning
  - Investigation
  - Implementation
  - Verification & Monitoring

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Retrocommissioning (RCx)

Retrocommissioning applies commissioning to an existing building.

1. Perform investigation
2. Make corrections
3. Validate performance

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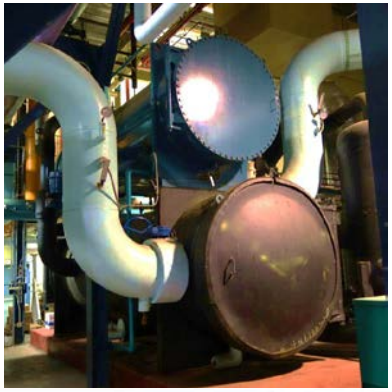
Logan International

Central Plant Retrocommissioning

- Cost for investigation phase: $120,000
  - Included hydraulic modeling for central plant and distribution systems throughout the airport with extensive field investigations
- Results:
  - Recommended $3.2 million in projects
  - Estimated cost avoidance $1.5 million per year



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Logan International

Central Plant Retrocommissioning

- Operational recommendations:
  - Decrease Differential Pressure Setpoints
  - Renovate Building Chilled Water Systems
  - Reset Chilled Water Supply Temperatures
  - Operate Only Electric Chillers
- Capital project recommendations:
  - Bypass Building Pumps
  - Upgrade & Expand Plant Metering
  - Address Steam System Losses
  - Install VFDs on Cooling Tower Fans
  - Install VFDs on Boiler Induced Draft Fans & Forced Draft Fans
  - Replace Compressors

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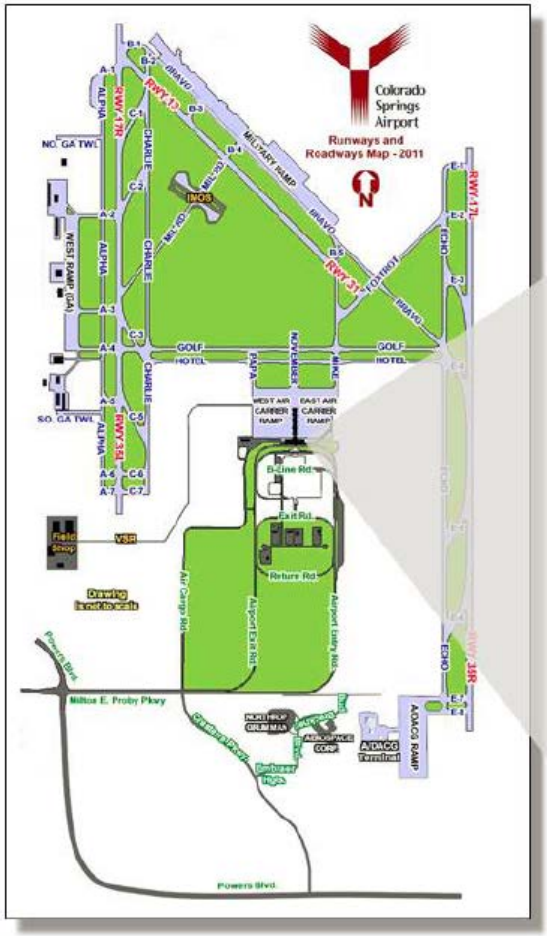
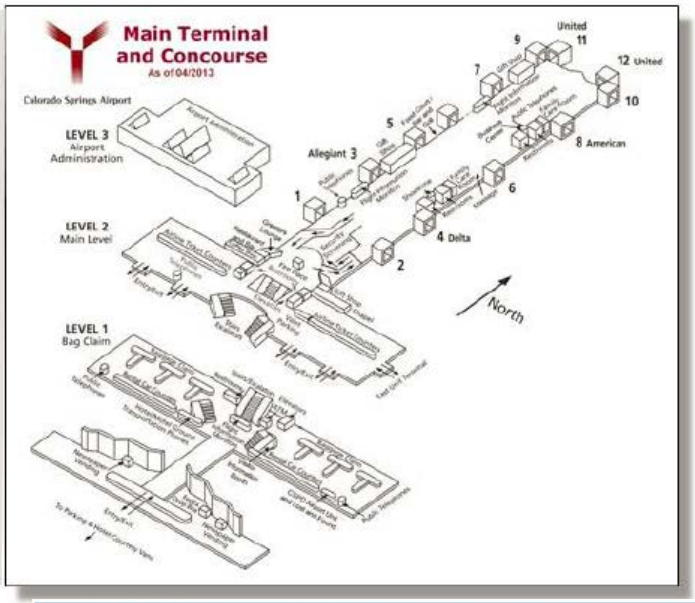
Summary of recommendations

- Estimated implementation cost
- Estimated annual cost avoidance
- GHG emissions avoided

ECMs		Implementation Plan	Estimated Implementation Cost - Engineering	Estimated Implementation Cost - Materials/ Labor	Estimated Implementation Cost - Total	Estimated Annual Utility Reductions				GHG Reduction (Metric Tons CO2)	Total Estimated Annual Cost Avoidance	Simple Payback (yrs)
ECM No.	ECM Description					Elec. (kWh)	N. Gas (Mcf)	Water (Mcf)	kBtu			
1	Bypass Building Pumps, Remove 3-Way Valves, Open Balancing Valves and Deny Valves, Piping Modifications	Facilities / Design - Bid - Build	$22,000	$78,000	$100,000	417,043			1,422,951	156	$47,126	2.1
2	Decrease Differential Pressure Setpoint/ Modify SCHW Pump Staging, Add Monitoring Points	Facilities/ Controls Contractor - Engineering Support	$6,000	$19,000	$25,000	218,713			746,249	82	$24,715	1.0
3	Renovate Building Chilled Water Systems	Facilities/ Term Contractors - Engineering Support	$41,000	$90,000	$131,000	454,668	1,586		3,137,327	255	$66,920	2.0
6	Reset chilled water supply temperature	Facilities/ Controls Contractor - Engineering Support	$8,000	$22,000	$30,000	68,000	2,800		3,032,016	174	$35,124	0.9
7	Operate Only Electric Chillers/ Upgrade Plant Metering	Facilities/ Design - Bid - Build	$65,000	$370,000	$435,000	3,041,091	110,824		100,447,798	4,744	$742,432	0.6
8	Address Steam System Losses	Facilities/ Vendors	$0	$120,000	$120,000		16,618	77	16,618,000	882	$171,856	0.7
	Totals		**$142,000**	**$699,000**	**$841,000**	**1,882,667**	**131,828**	**77**	**125,404,340**	**6,294**	**$ 1,088,173**	**0.8**

Colorado Springs





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Colorado Springs

"Leveraging a Utility Conservation Program"

- ASHRAE Level 1 Energy Audit by third party
  - 11 low-cost recommendations
  - 10 recommendations requiring capital budgeting
- Implemented:
  - $60,081 in lighting upgrades with payback less than 2 years
  - Improvements to tenant kitchen equipment
  - Revisions to building pressurization and economizer operation
  - Revisions to control point dead bands; pneumatic and DDC
  - Supply air temperature reset based on outside air temp
  - Static pressure reset to control VAV supply fans

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Minneapolis-Saint Paul

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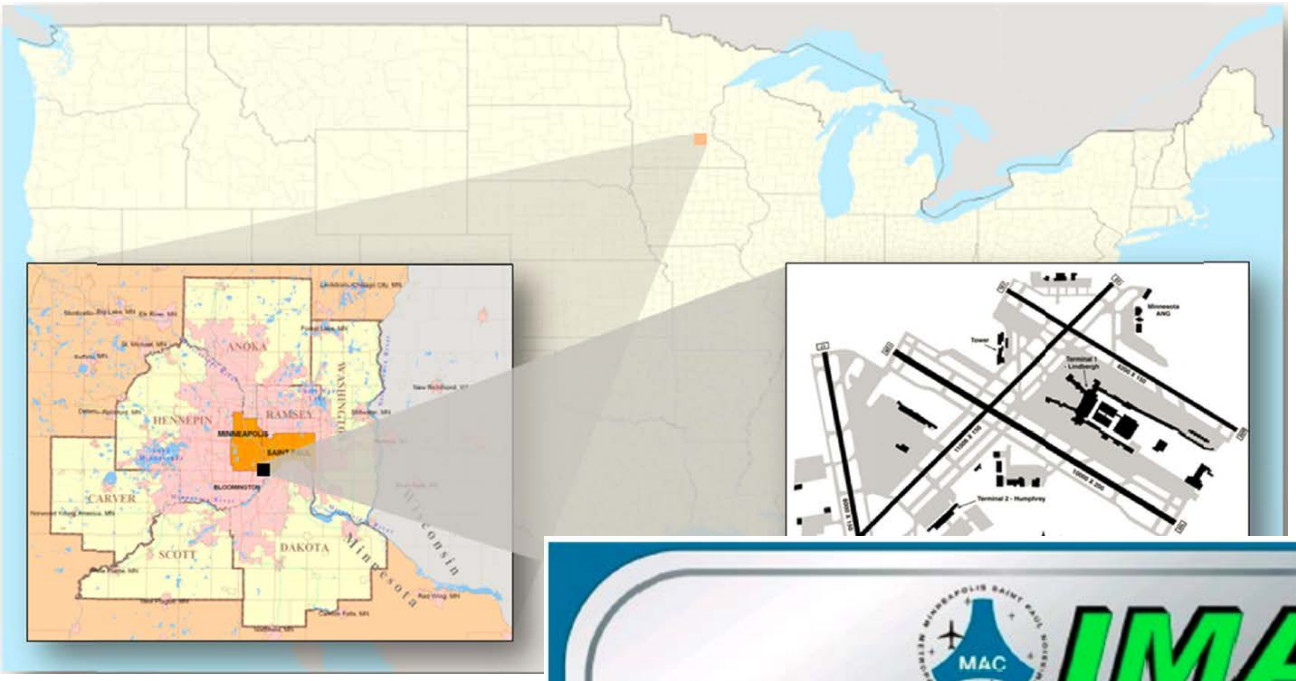

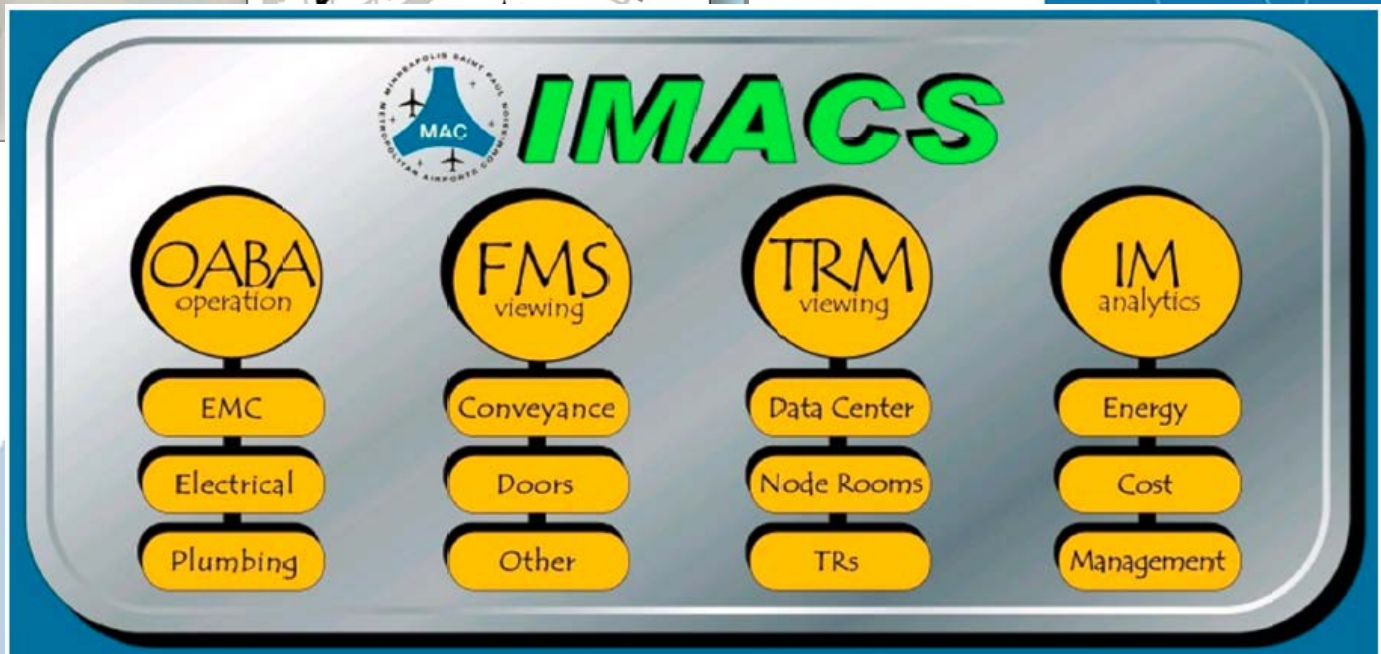

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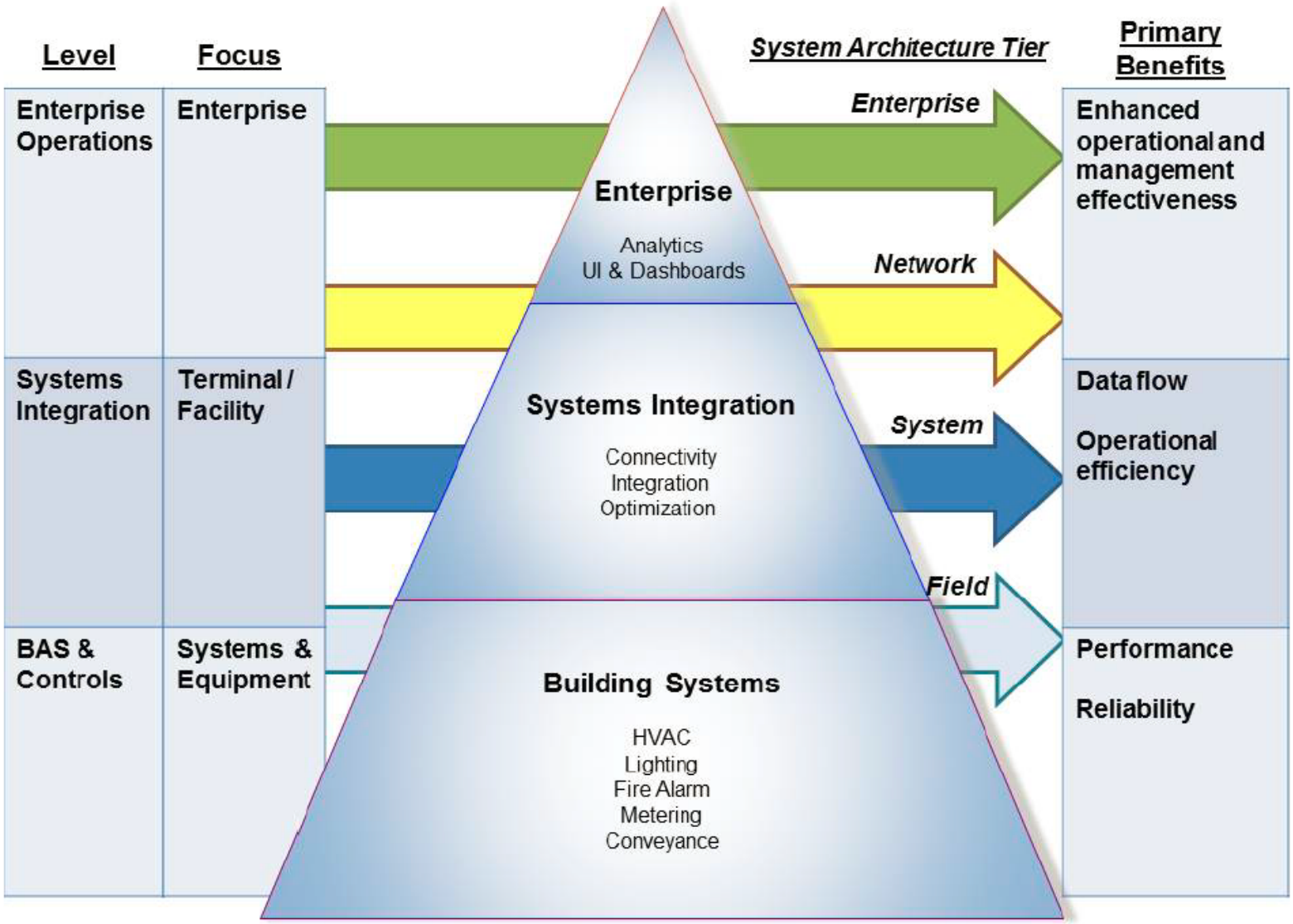

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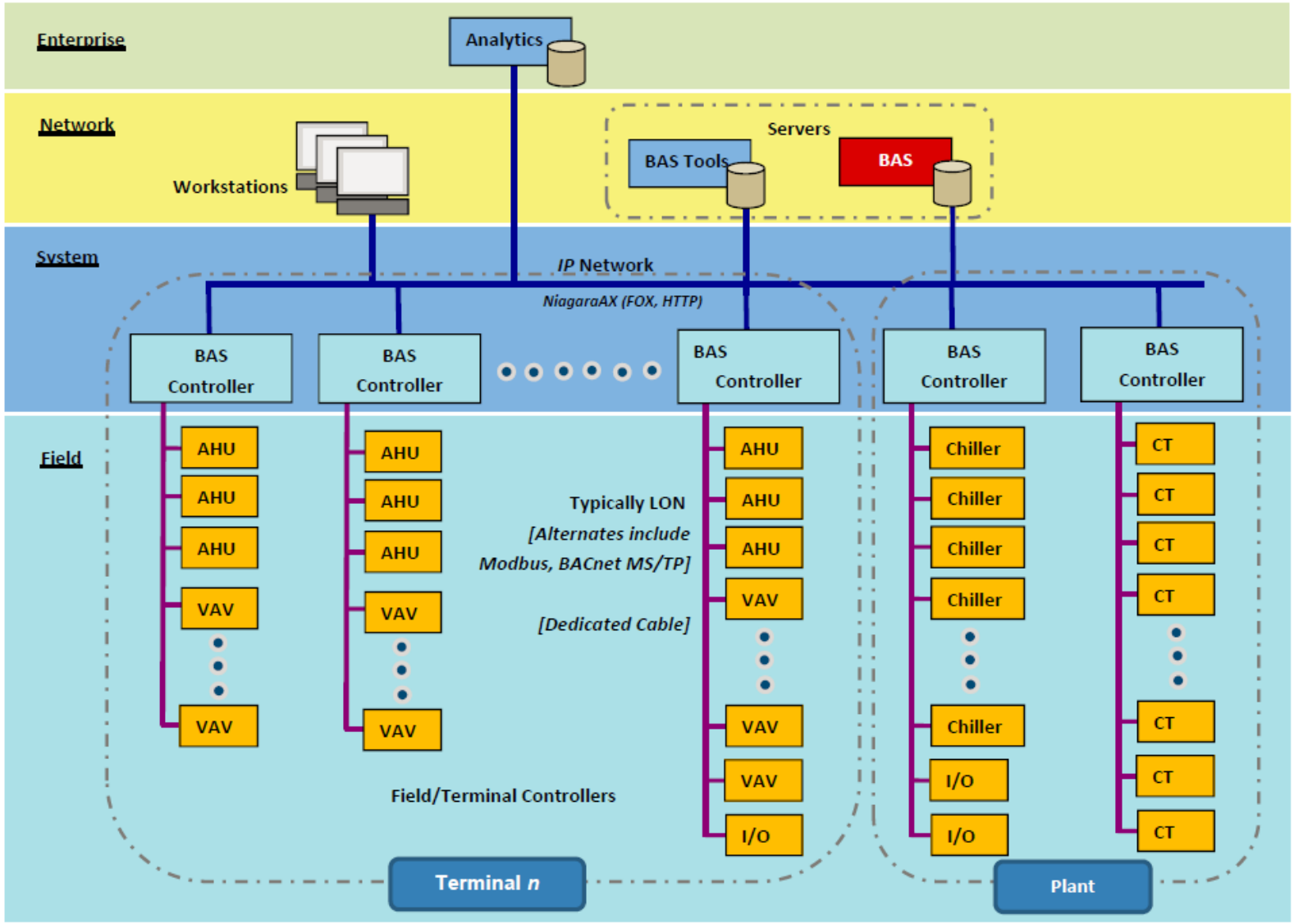

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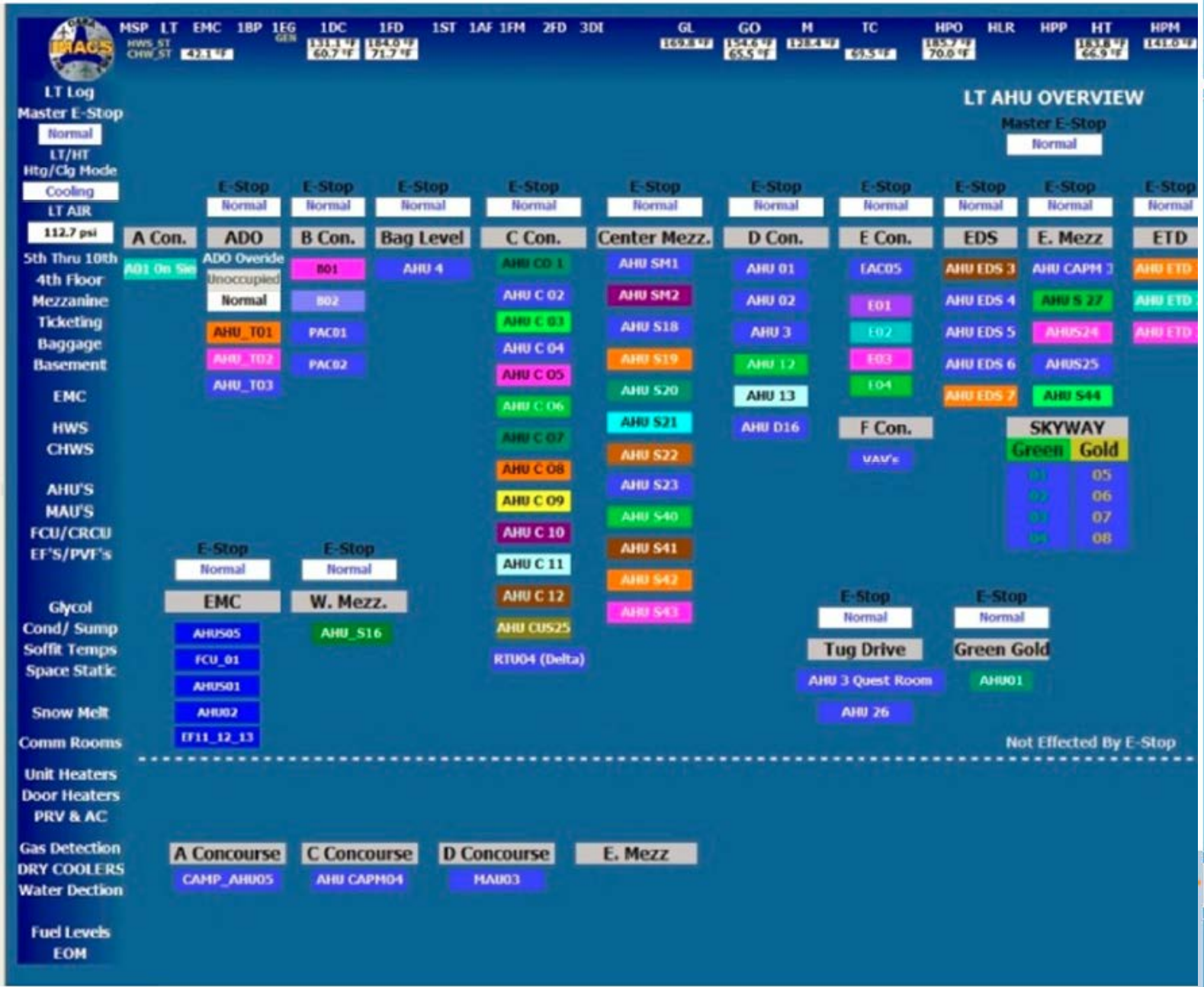

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Critical Success Factors

- Obtain executive level support for the program
- Integrate first time and ongoing component procurement into appropriate budgets
- Delegate responsibility for updating controls systems to a single individual to ensure consistency and uniform development

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Summary from Case Studies

1. Get the right people at the table
2. Engage a third party
3. Commit to implementation

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Optimization through RCx

- *Define objectives:*
  - *Energy reductions (evaluate utility rebate programs)*
  - *Resolve chronic equipment failures*
  - *Improve occupant comfort*
- *Scope the project:*
  - *Project boundaries*
  - *Building systems*
  - *Functional testing & trending performance*
- *Budgeting/procurement:*
  - *Target for annual savings (energy, maintenance, etc.)*
  - *Identify budget for quick fixes*
  - *Estimate labor to perform assessment & investigation*

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Planning for RCx

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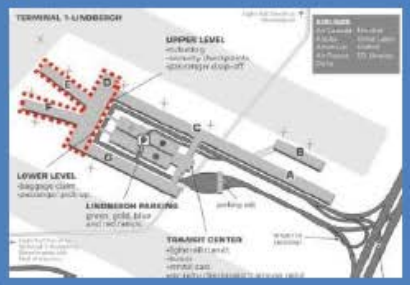
Identify Project Scope



Potential Considerations:
- Building Footprint
- Control System
- AHU/Pressure Zones
- Chronic repair issues
- Area Use
  - Secure Passengers
  - General Public
  - Baggage Handling

Feasibility/Limits

Potential Considerations:
- System configuration
- Number of AHUs
- Number of VAVs
- Space uses
- Building vintage

Finalize Scope of Work

Request for Proposals and Budgeting

Revise Scope as Necessary to Meet Budget/Time Constraints

RCx Process

Investigation

- *Collect operational data, test systems, complete technical analysis and provide recommendations*

Implementation

- *Execute approved changes, provide training as appropriate*

Verification & Monitoring

- *BAS trending, measurement & verification, recommissioning, ongoing commissioning*

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Report 139: Optimizing O&M

Tools for Implementation

- *Process map with detailed descriptions*
- *Sample retrocommissioning scopes of work*
- *Sample retrocommissioning plans*
- *Sample optimization reports*
- *Master list of recommendations*
  - *Ranking tool for prioritization*

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G - Master List of Recommendations.xlsx [Read-Or

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Airport Facility Optimization Ranking Tool

Introduction: Retrocommissioning efforts often uncover many energy and cost saving opportunities, but many times budget or resource constraints hinder implementation efforts. The SIMPLE list provides a Master List of best practices for optimizing facilities and reducing lifecycle costs. The ADVANCED tool seeks to help teams pursuing retrocomissioning to prioritize opportunities based on 5 criteria:

Implementation Costs This measure includes all costs associated with the effort including capital costs, design / consulting fees, etc.

Potential Cost Savings This measure incluedes all cost savings which could be in the form of lower utility bills, avoided maintenance, lower insurance premiums, lower liabilities, etc.

Estimated Difficulty This measure evaluates how much effort is required and whether or not the project team would likely need to seek help from outside architects, engineers, consultants, etc.

Visibility This measure evaluates likelihood that the airport's stakeholds (passengers, local community members, etc.) will notice the implementation of the effort.

GHG Savings This measures the relative impact on greenhouse gas emission reduction.

Each retrocomissioning opportunity is scored qualitatively on each of the 5 criteria based on the descriptions in the following table. The user assigns a weighting factor to each of the crieria based on the project team's priorities. Note that the sum of all 5 criteria's weighting factors must equal 100% (the GHG Savings weighting will calclulate automatically to ensure this). A "weighted score" is calculated for each retrocomissioning opportunity which helps to prioritize efforts for the project team (higher weighted scores imply higher priority opportunities).

	Implementation Costs	Potential Cost Savings	Estimated Difficulty	Visibility	GHG Savings
Weighting	30%	35%	10%	20%	5%
5	easy, no cost	major savings	easy	highly visible	major savings
4	internal effort, or low cost	significant savings	internal coordination	more visible	significant savings
3	consultant, or other moderate cost	some savings	external coordination	visible to staff	some savings
2	capital cost	minimal savings	leadtime & planning required	less visible	minimal savings
1	major cost	no savings	very difficult	back of house	no savings

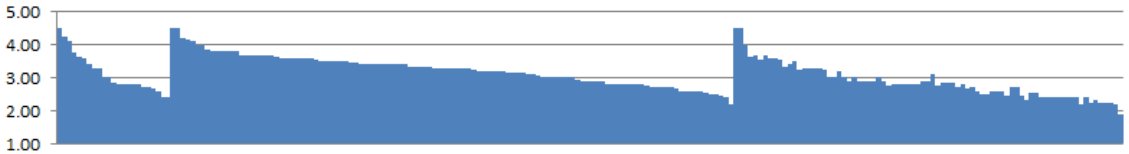
Adjust the weighting if necessary by overwriting the default values at the top of the "Master List" worksheet.

The summary worksheet groups each retrocommissioning opportunity by category, goal, or timeframe. On this page you can determine

P2

Airport Facility Optimization

Master List of Recommendations



	Implementation Costs	Potential Cost Savings	Estimated Di
Weighting	30%	35%	10%
5	easy, no cost	major savings	easy
4	internal effort, or low cost	significant savings	internal coord
3	consultant, or other moderate cost	some savings	external coord
2	capital cost	minimal savings	leadtime & pl require
1	major cost	no savings	very diffi

Flag?	Source	Reference	Category	Goal	Measure/Objective	Timeframe	Implementation Costs	Potential Cost Savings	Estimated Di
Yes	SAGA	239	Water Use	Reduce Water Use	Provide training for employees and signage for facility users instructing them on how they can help reduce water use.	Immediate	5	4	5
Yes	SAGA	23	Operations	Reduce Costs	Develop and implement a recycling program for day to day airport operations (employees, passengers, concessions).	Midterm	4	4	5
Yes	SAGA	465	M&V	Improve Operation	Require building staff participation during commissioning and testing and balancing activities.	Immediate	5	4	5
Yes	SAGA	378	Energy Performance	Reduce Energy Use	Use a maintenance log to track energy use processes, problems, and ideas.	Immediate	5	3	5
Yes	SAGA	370	Energy Performance	Reduce Energy Use	Develop baseline energy consumption (e.g., perform an energy audit of buildings and facilities).	Midterm	3	5	4
Yes	SAGA	376	Energy Performance	Reduce Energy Use	Conduct and implement recommendations from an energy audit periodically (e.g., every 4 years).	Longterm	3	5	2
Yes	EERE	86-10	IT	Reduce Energy Use	Use network presence proxy for PC power management	Midterm	4	3	4
No	EERE	66-7	Energy Performance	Reduce Energy Use	Paint exterior walls with a cool paint color	Midterm	4	2	5
Yes	SAGA	453	Renewable Energy	Reduce Energy Use	Utilize wind power (wind turbines) where appropriate.	Longterm	2	4	1
Yes	SAGA	445	Renewable Energy	Reduce Energy Use	Install solar-thermal powered water heaters.	Longterm	2	4	2
Yes	SAGA	446	Renewable Energy	Reduce Energy Use	Install solar Trombe walls for passive solar heating.	Longterm	2	4	2
Yes	EERE	74-8	HVAC	Reduce Energy Use	Utilize dual source heat pumps	Longterm	2	4	3

For additional information:

ACRP Report 139*: Airport Building O&M Optimization and Retrocommissioning: A Whole-Systems Approach*

http://onlinepubs.trb.org/Onlinepubs/acrp/acrp_rpt_139.pdf

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ACRP Report #92: Creating a Collaborative Environment between Airport Operations and Maintenance Departments

Steve Wareham, Trillion Aviation
Mike Nichols, Amadeus Consulting

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TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Steve Wareham, A.A.E.

- Vice President, Trillion Aviation
- Co-Investigator
- Former Director, MSP Operations
- Board Member, Airport Foundation, MSP

Mike Nichols, Amadeus Consulting

- Co-Investigator
- Director of Client Experience
- Contracts Administrative Officer

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ACRP Report 92 Oversight Panel

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- TRB Staff Representative, Ms. Marci A. Greenberger, AAE, Senior Program Officer, Transportation Research Board
- Mr. Travis A. Crilly, Operations Specialist, Lexington Bluegrass Airport
- Mr. Michael J. Kaminski, Facilities Maintenance Supervisor, Tucson Airport Authority
- Mr. Chad R. Makovsky, Deputy Aviation Director - Operations, City of Phoenix
- Ms. Jennifer Mims, Senior Manager, Maintenance, Port of Seattle
- Dr. Maureen Pettitt, Director of Institutional Research, Planning and Effectiveness, Skagit Valley College
- Ms. Mindy Price, Principal Consultant, Direct Effect Solutions
- TRB Liaison Representative, Mr. Richard A. Cunard, Senior Program Officer – Traffic and Operations Engineer, Transportation Research Board
- Liaison Representative, Dr. Michel Hovan, Manager, Airports, Engineering & Safety Standards Branch, Federal Aviation Administration

ACRP Report #92: Guidebook to Creating a Collaborative Environment Between Airport Operations and Maintenance

- Provides tools and strategies that can be used to increase and improve collaboration between operations and maintenance staffs at airports
- Tools include exercises, case studies, and other resources
- Provides methods to identify warning signs of collaboration issues between operations and maintenance staffs
- Identifies root causes
- Includes a Toolbox Mapping Worksheet strategy to simplify implementation
- Published October 2013

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Introduction to the Research Problem

Why does there seem to be less collaboration between Operations and Maintenance in comparison to other departments and divisions within airport organizations?

- Operations and maintenance departments at airports must rely on each other to ensure a safe, secure, and efficient operation of an airport
- They don't always share a clear understanding of each other's responsibilities, which can sometimes lead to counterproductive working relationships
- Operations and maintenance may often report to different people, leading to competing priorities for day-to-day responsibilities

Defining Collaboration

According to the Merriam-Webster dictionary, the definition of the word “collaborate” is “to work jointly with others or together especially in an intellectual endeavor” or “to cooperate with an […] instrumentality with which one is not immediately connected.” Essentially, collaboration is nothing more than **“Individuals working together towards a common goal.”**

Research Process

The Research Team collected inputs from more than 70 airport teams:

- Extensive Literature Review
- Case Studies
- Focus Groups
- One-on-One Interviews (phone or in-person)
- Online Surveys
- Participation from Small, Medium, Large and Non Hub airports

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Assessing an Airport's Current State

The Guidebook includes instructions on how to administer a Collaboration Survey:

- The most comprehensive and measureable approach to assessing the current state
- Involve large groups of team members at all levels
- Time efficient
- Enables filtering and analyzing survey results
- Recommended survey questions included
- Found in Appendix D: Creating a Survey Tool

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Assessing an Airport's Current State – Administering a Survey

A Subset of Survey Questions

4. Please indicate the extent to which you agree or disagree with each of the following statements:

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree	N/A	Response Count
I understand the process for a work order system, from entering the first request through repair/replacement and close-out.	3.3% (7)	3.3% (7)	9.3% (20)	31.2% (67)	**48.4% (104)**	4.7% (10)	215
I use checklists for routine work such as inspections, terminal tours, etc.	1.4% (3)	9.3% (20)	14.9% (32)	**37.2% (80)**	30.2% (65)	7.0% (15)	215
I consider the physical work environment efficient for completing my work and collaborating with others	0.5% (1)	6.5% (14)	14.4% (31)	**52.6% (113)**	22.8% (49)	3.3% (7)	215
I clearly understand the "Vision" of my organization.	1.9% (4)	8.4% (18)	12.1% (26)	**47.0% (101)**	30.2% (65)	0.5% (1)	215
This "Vision" helps my organization work together.	2.3% (5)	12.1% (26)	24.7% (53)	**39.1% (84)**	20.9% (45)	0.9% (2)	215
The culture of my department enables collaboration.	1.9% (4)	15.3% (33)	20.5% (44)	**42.8% (92)**	18.6% (40)	0.9% (2)	215
My organization is more reactive than proactive.	3.7% (8)	24.7% (53)	26.5% (57)	**31.2% (67)**	14.4% (31)	0.5% (1)	215
We use planners to schedule our daily work.	9.3% (20)	31.2% (67)	15.8% (34)	**31.6% (68)**	5.6% (12)	6.5% (14)	215
I am allowed a certain amount of flexibility in the way I complete my work.	0.5% (1)	1.9% (4)	9.3% (20)	**53.5% (115)**	34.0% (73)	0.9% (2)	215

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Interpreting the Results

Strategies are provided for analysis and comparison of survey results:

- Compare mean survey scores with those of the broader airport population
- Identify areas of significant variance
- Look for potential disconnects between organizational levels
- Analyze across each of the demographics areas represented
- Review of the open ended responses
- Guidance for conducting a Focus Group is provided as an alternative or addition to online surveys

Using the Collaboration Toolbox

26 Strategies to improving collaboration are provided within the Collaboration Toolbox:

Identified Warning Signs	Possible Causes	Strategies for Fostering Collaboration
#11 : Not comfortable delegating tasks	17, 18, 19, 20, 22, 26, 34, 35, 36, 38, 39	6 and 17 – Building Trust and Building Respect

Use the Current State Assessment to identify Warning Signs and Possible Causes, then apply the referenced strategies from the Collaboration Toolbox.

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Identify Warning Signs

Our research identified 48 Warning Signs (outlined in Chapter 3) that can indicate collaboration issues:

- Abnormally high levels of disciplinary action in one or both divisions
- Conflict within employee ranks
- Confusion as to who is responsible for what activity
- Decisions made without input from stakeholders
- Lack of comfort with delegating tasks
- Unwillingness to accept constructive criticism
- High absenteeism
- High turnover in supervisory personnel

Identify Possible Causes

The Warning Signs can each be mapped to one or more Possible Causes. Chapter 4 describes the process of mapping these relationships as a scenario:

The Maintenance Supervisor has noticed that some of the Maintenance group are exhibiting "if you want it done right, do it yourself" attitudes, which has resulted in animosity between certain team members, process slowdowns, and excessive workloads for certain members.

Referring to the Collaboration Toolbox, the Maintenance Supervisor narrows this issue down to "Employees not comfortable delegating tasks" and finds the following entry:

> **Employees are not comfortable delegating tasks. Certain employees exhibit a "if you want it done right do it yourself" attitude.** This unwillingness to delegate tasks results in process slowdowns and uncompleted tasks, and contributes to silos of skills and knowledge in the organization. *Possible Cause Numbers: 17, 18, 19, 20, 22, 26, 34, 35, 36, 38, and 39.*

Identify and Implement Strategies for Fostering Collaboration

Chapter 5 Strategies represent both tactical and strategic approaches to removing barriers to collaboration. Examples of Strategies include:

- Aligning Priorities
- Building Trust
- Conflict Resolution
- Embracing Change
- Improving Communication
- Mentoring Programs
- Addressing Generational Differences

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Assess Results and Repeat the Process

- Complete a follow-on assessment
- Gain insight to the impacts of the strategies selected
- Determine improvements that have been realized in interdepartmental collaboration.
- Identify the next level of priorities to address
- If the initial effort was ineffective, determine additional possible causes and appropriate strategies to implement

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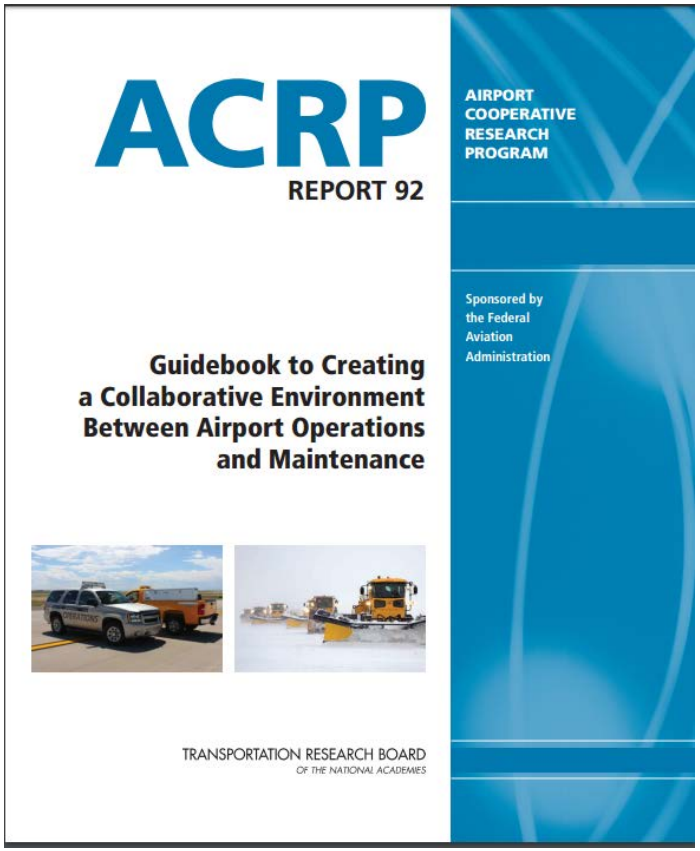
For additional information:



ACRP Report 92*: Guidebook to Creating a Collaborative Environment Between Airport Operations and Maintenance*

http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_092.pdf

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