Quantifying the Impacts of Delayed Maintenance of Airport Assets

June 25, 2025
1-2:30 PM

NATIONAL ACADEMIES *Sciences Engineering Medicine*

TRB TRANSPORTATION RESEARCH BOARD

ACRP AIRPORT COOPERATIVE RESEARCH PROGRAM

Today's Learning Objectives

1. Use a framework, process, and tools to quantify the impact of delayed preventive maintenance on airport budgets and assets

2. Explain how an asset management plan supports preventive maintenance and extends asset service life

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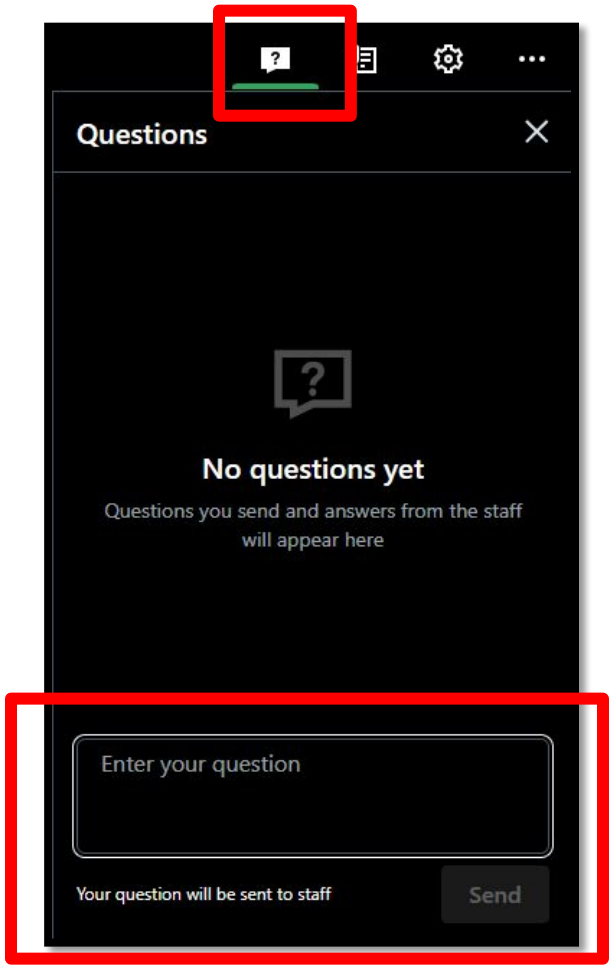

Today's Speakers

Pramen P. Shrestha, PhD, PE, F. ASCE
pramen.shrestha@unlv.edu
University of Nevada, Las Vegas

Bill Robert
wrobert@spypondpartners.com
Spy Pond Partners

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Quantifying the Impacts of Delayed Maintenance of Airport Assets
A Guide

Pramen P. Shrestha, PhD, PE, Fellow ASCE
Bill Robert

NATIONAL ACADEMIES Sciences Engineering Medicine

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Pramen P. Shrestha, PhD, PE, F. ASCE
Principal Investigator

- Professor and Chair, Civil & Environmental Engineering & Construction Department, University of Nevada, Las Vegas
- Over 20 years of research experience on Asset Management, Life-Cycle Cost Analysis, and Project Management
- 8 Years of professional experience on infrastructure design and build projects

Bill Robert
Senior Analyst

- Partner, Spy Pond Partners
- Experienced in asset management for highway, transit and airports
- Senior Analyst for NCHRP Projects 14-20 and 14-20A on effects of delayed maintenance for highway assets
- Principal Investigator
  - NCHRP Project 23-06 on asset valuation
  - TCRP Projects E-09, E-09A, E-11 and E-12 on transit asst management

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Cathryn Stephens, Eugene Airport

Introduction

Scope and Objectives

- Airport owners do not have sufficient funding to conduct preventative maintenance of their assets
- Preventative maintenance planning is key in maximizing their assets' life
- This study provide the guide and tool to help airport owners to quantify the impact of delayed maintenance
- Objectives
  - Identify maintenance budget preparation processes
  - Develop framework to quantify the consequences of delayed maintenance
  - Develop spreadsheet tool to quantify the impact of delayed maintenance of 4 airside and 5 landside assets

Research Approach

Phase I

- Literature Review, Interviews with Airport Asset Managers to identify
  - State of practices in asset management and maintenance planning
  - Framework, tools, and models to predict impact of delayed maintenance in airport and another assets

Phase II

- Data Collection to develop
  - Framework, models, and spreadsheet tools to determine the impact of delayed maintenance for 9 airport assets

Summary of Relevant Literature

General Asset Management References

- AASHTO Transportation Asset Management Guide: A Focus on Implementation, 2nd Edition (2020)
  - Digital version at www.tamguide.com
- International Infrastructure Management Manual (IIMM), 6th Edition (2024)
- Institute for Asset Management (IAM) Asset Management Anatomy Version 4 (2024)
- International Standards Organization (ISO) 55000 Series: Asset Management

Airport-Specific Literature

- ACRP Report 69: Asset and Infrastructure Management for Airports – Primer and Guidebook (2012)
- ACRP Report 138: Preventive Maintenance at General Aviation Airports (2015)
- ACRP Report 172: Guidebook for Considering Life-Cycle Costs in Airport Asset Procurement (2017)

Lessons Learned from Prior Research

Lesson 1: Importance of Asset Management and Maintenance is Well Established

- ISO 55000 and IAM Asset Anatomy establish overall standards
- Other guides reviewed translate provide details on concepts – e.g., the AASHTO TAM Guide and the IIMM
- ACRP Reports 69 and 138 put asset management concepts into context for airports

Lesson 2: Specific Quantification of Costs and Benefits of Asset Maintenance Is Elusive

- Most guidance is high-level, often applicable to a wide range of asset classes and modes
- In many cases the argument over importance of asset management is settled, thus there is little focus on demonstrating benefits of maintenance
- Quantifying the benefits can require consideration of difficult-to quantify factors such as asset costs, maintenance cost, and failure risk

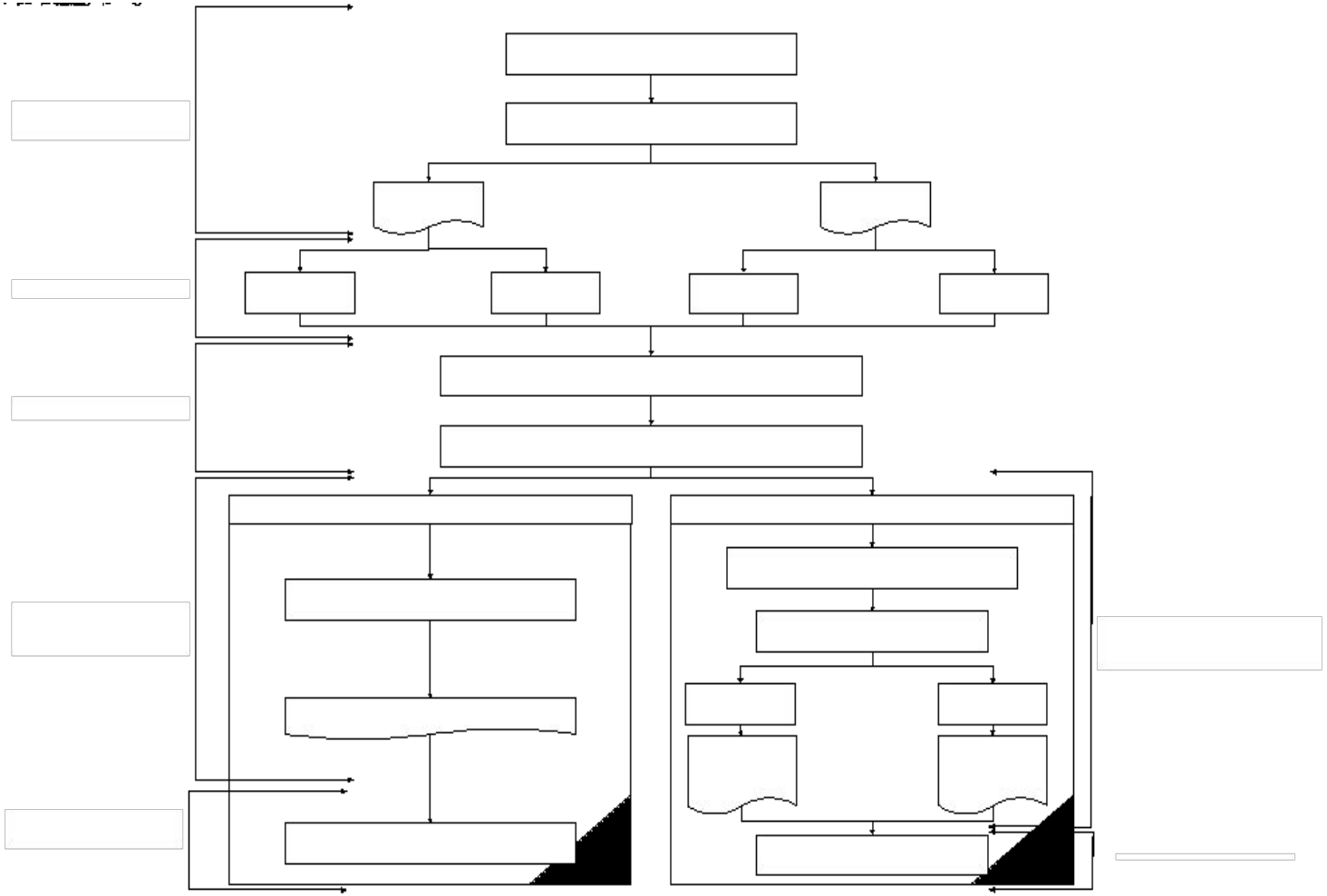
Impact of Delaying Maintenance

Airport Asset Classifications

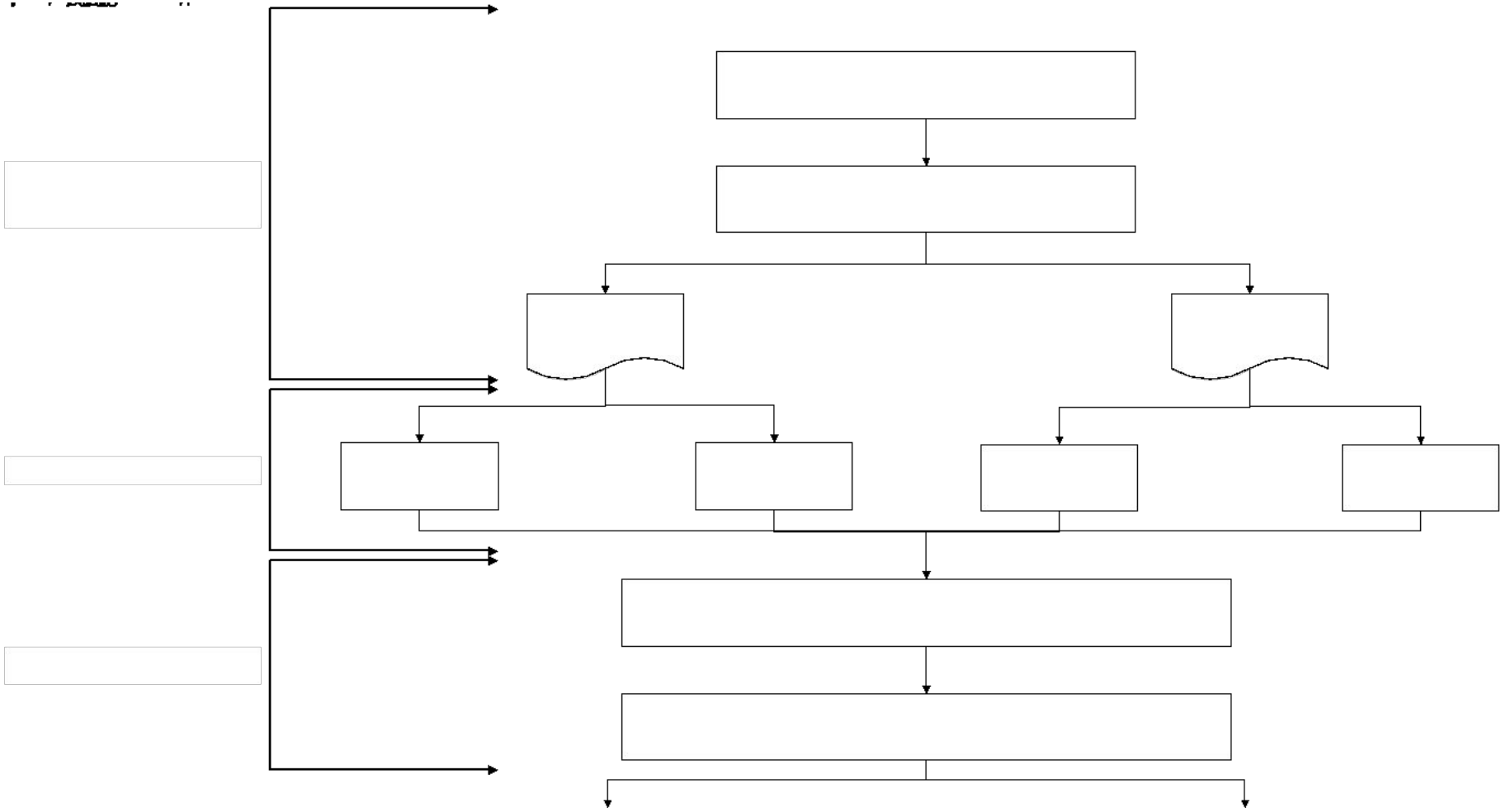
Asset Classes

- Airside
  - Primary Runway Pavement
  - Airfield Markings
  - Runway Lighting
  - Airfield Signs
  - Airfield Visual & Navigational Aids (NAVAIDS)
- Landside
  - Airport Service Vehicles – Pickup Trucks
  - Airport Snow Removal Equipment
  - HVAC Systems
  - Baggage Handling System
  - Passenger Boarding Bridges
  - Airport Hangars
  - Terminal & Administrative Buildings
  - ARFP Pickup Truck
  - Fuel Faculties
  - Automated People Mover Systems

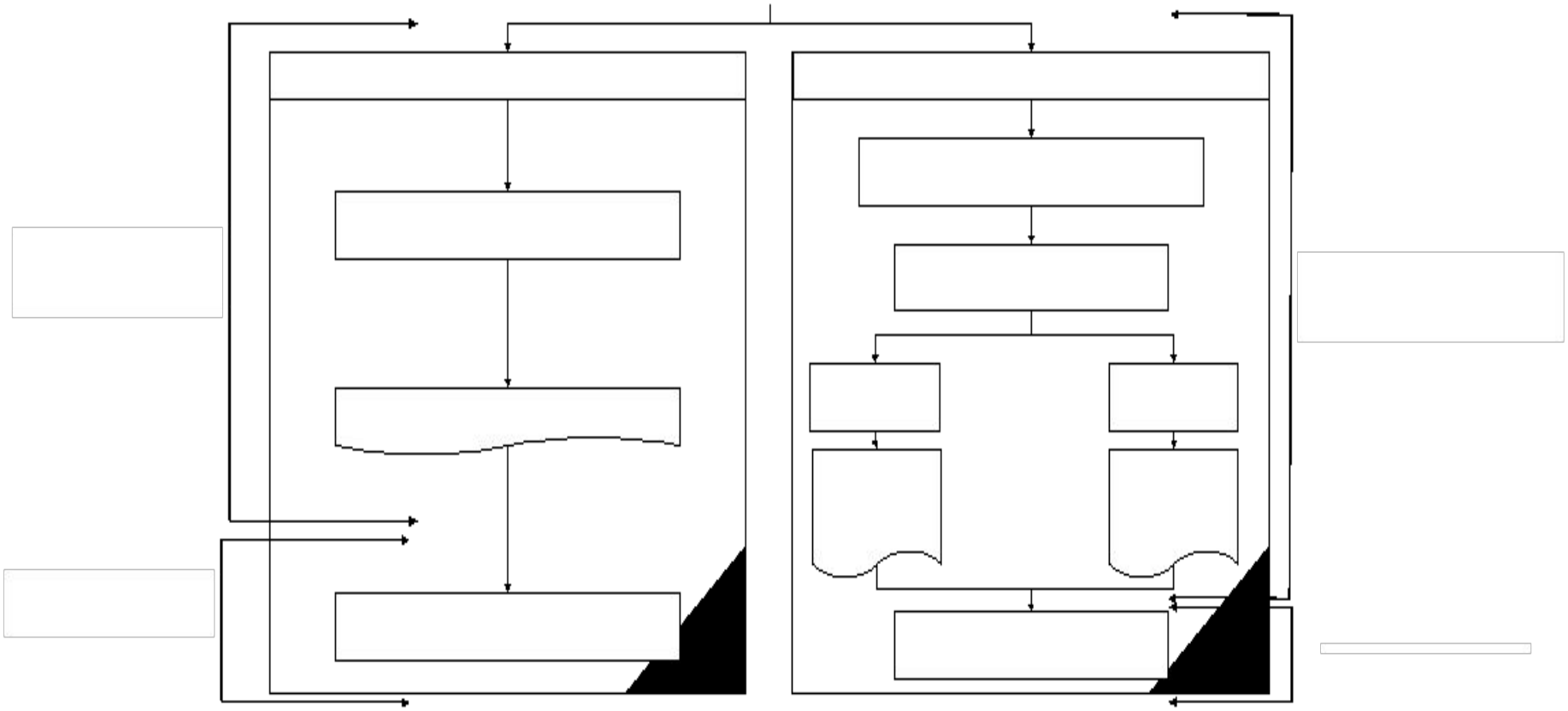
Framework for Quantifying Delayed Maintenance – Primary Runway Pavement



Framework for Quantifying Delayed Maintenance – Primary Runway Pavement



Framework for Quantifying Delayed Maintenance – Primary Runway Pavement



Spreadsheet Tool to Calculate Impact of Delayed Maintenance

Modeling Approach Used

- Spreadsheet will calculate
  - Regular Maintenance Cost
  - Deferred Maintenance Cost – Delayed Scenario
- For Airport Runway Pavement – Deterioration Curves Used
  - Asphalt and concrete PCI has relationship with age of the pavement
- For Equipment Modeling – Probability of Failure
- Simulate application of each strategy and compare costs

Spreadsheet Tool to Calculate Impact of Delayed Maintenance

Asset and Maintenance Costs

- Asset purchase cost is based on 2022
- However the cost will be adjusted based on the inflation factor used in the spreadsheet
- If the airport wants to use their own purchase cost, they can overwrite the cost used in the spreadsheet
- Maintenance cost used in the spreadsheet is based on 2022 and collected during the research.
- If the airport has their own maintenance cost, the airport can overwrite the maintenance cost

Spreadsheet Tool to Calculate Impact of Delayed Maintenance

Inflation & Time Value of the Money

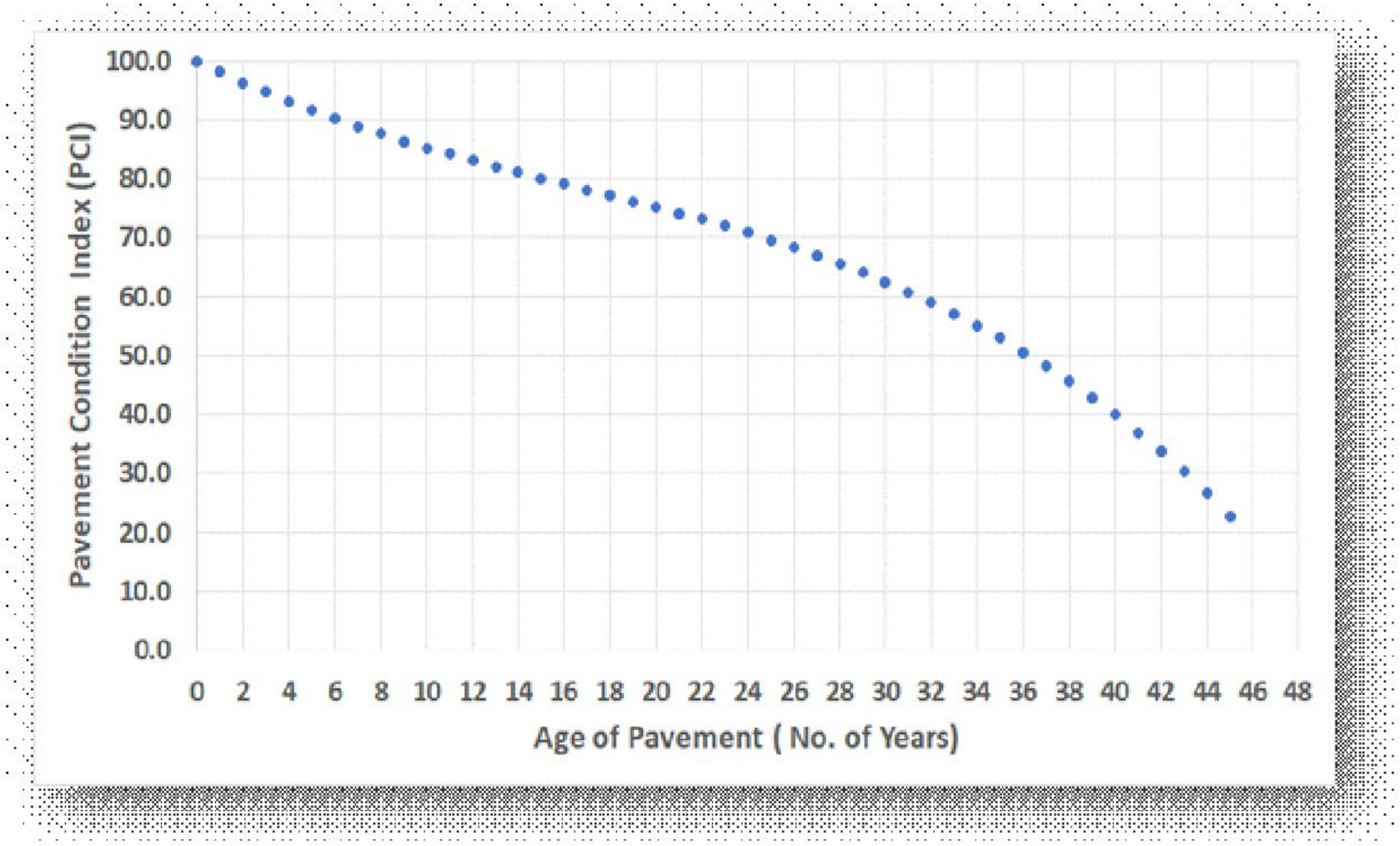
- The tool can be used in the future. If the cost database used in the spreadsheet must be inflated
- The cost inflation factor can be selected or input by the airport
- In delayed scenarios
  - The airports can select the number of years to be delayed (Maximum of 10 years of delayed maintenance)
  - To convert the future value to present value of delayed maintenance costs, the airport can select the discount rate
    - The maximum discount rate used in the spreadsheet is 7%

Condition of Airport Pavement (FAA PAVEAIR)

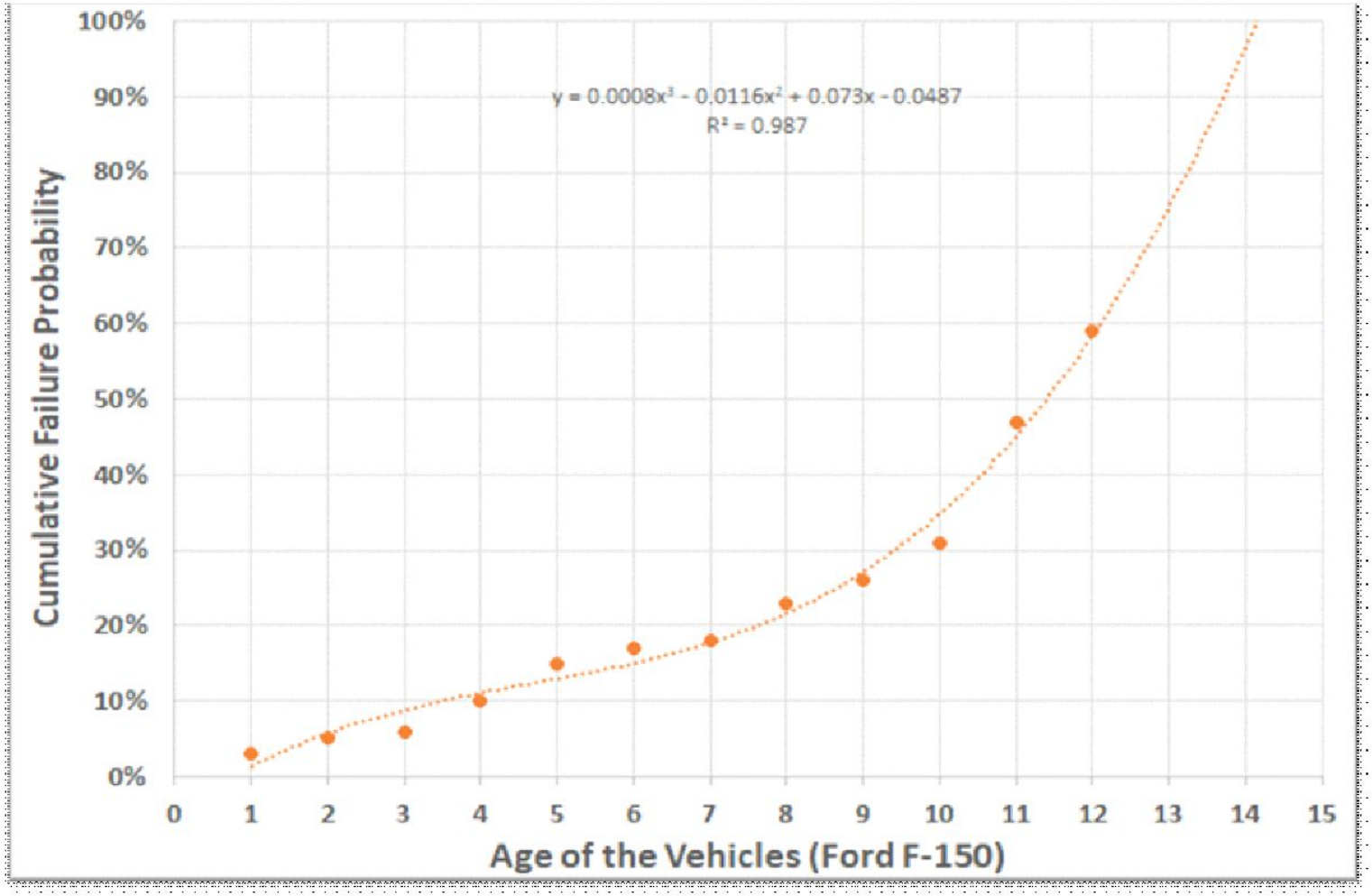
Condition Category

- Pavement Condition Index (PCI)
  - PCI – 85 to 100 – Minimum preventative maintenance
  - PCI 70 to 85 – Some preventative maintenance required
  - PCI 55 to 75 – High preventative maintenance required
  - PCI 55 to 40 – Rehabilitation
  - PCI below 40 – Reconstruction

Relationship between Age of Pavement & PCI



Cumulative Failure Probability Ford F-150



Spreadsheet Calculation Limitations

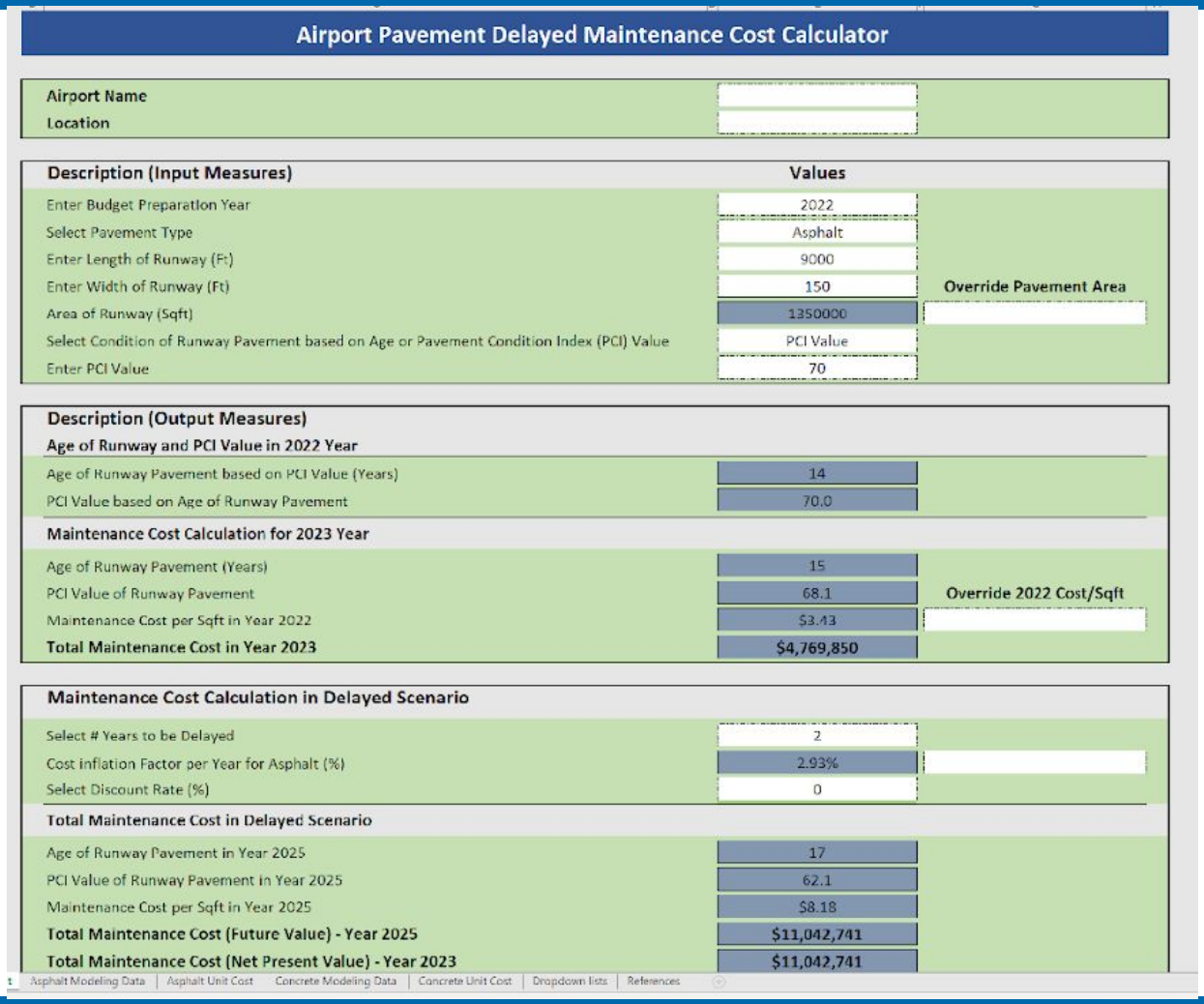
Recomendations

- Airports may use the spreadsheet tool to estimate the regular & delayed maintenance cost to prepare a budget

Constraints

- Airports must use the failure probability provided in the model
- If the airport does not have initial asset costs and maintenance cost, the delayed maintenance cost might not be accurate
- In regular scenario, the research team has collected the maintenance cost, it might not be accurate for each airport

Airport Runway Pavement Delayed Maintenance Calculator



Airport Pavement Delayed Maintenance Cost Calculator

Airport Name	
Location	

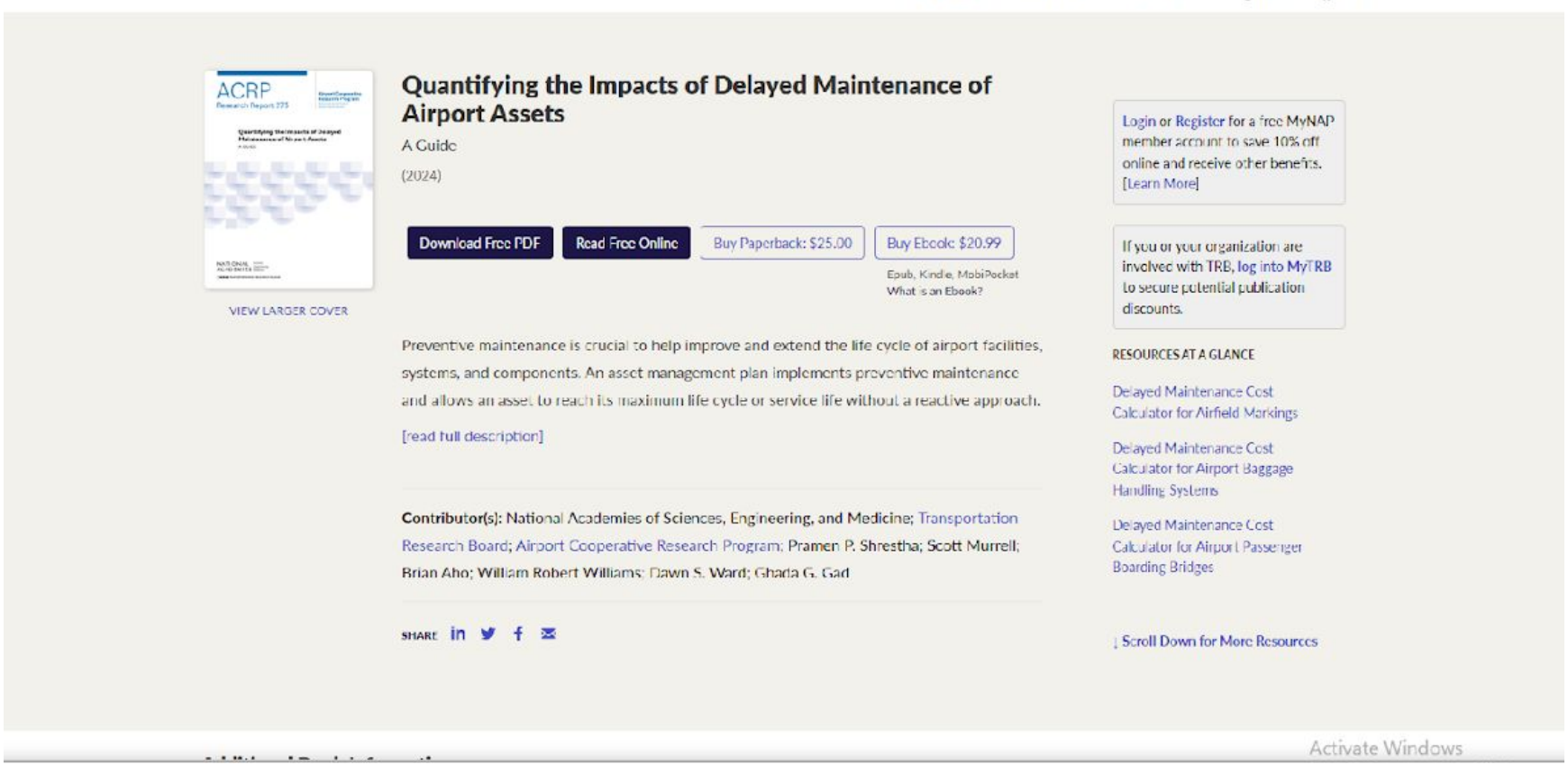
Description (Input Measures)	Values	
Enter Budget Preparation Year	2022	
Select Pavement Type	Asphalt	
Enter Length of Runway (Ft)	9000	
Enter Width of Runway (Ft)	150	Override Pavement Area
Area of Runway (Sqft)	1350000	
Select Condition of Runway Pavement based on Age or Pavement Condition Index (PCI) Value	PCI Value	
Enter PCI Value	70	

Description (Output Measures)		
Age of Runway and PCI Value in 2022 Year		
Age of Runway Pavement based on PCI Value (Years)	14	
PCI Value based on Age of Runway Pavement	70.0	
Maintenance Cost Calculation for 2023 Year		
Age of Runway Pavement (Years)	15	
PCI Value of Runway Pavement	68.1	Override 2022 Cost/Sqft
Maintenance Cost per Sqft in Year 2022	$3.43	
Total Maintenance Cost in Year 2023	**$4,769,850**	

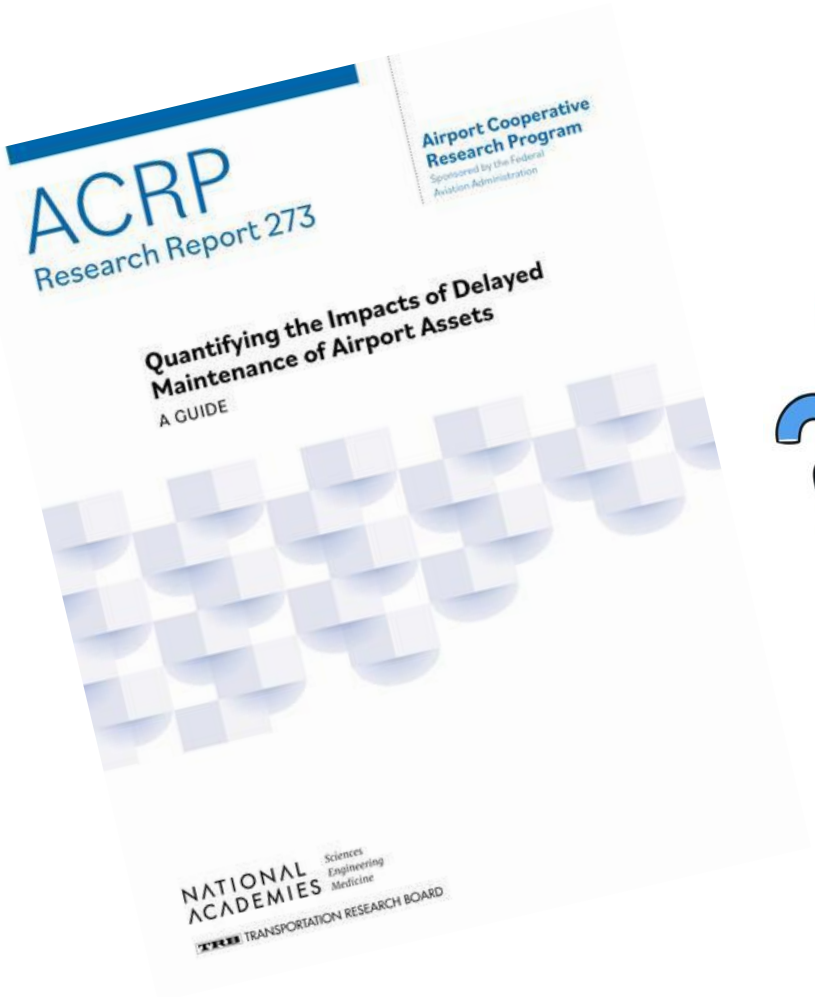
Maintenance Cost Calculation in Delayed Scenario		
Select # Years to be Delayed	2	
Cost inflation Factor per Year for Asphalt (%)	2.93%	
Select Discount Rate (%)	0	
Total Maintenance Cost in Delayed Scenario		
Age of Runway Pavement in Year 2025	17	
PCI Value of Runway Pavement in Year 2025	62.1	
Maintenance Cost per Sqft in Year 2025	$8.18	
Total Maintenance Cost (Future Value) - Year 2025	**$11,042,741**	
Total Maintenance Cost (Net Present Value) - Year 2023	**$11,042,741**	

Asphalt Modeling Data | Asphalt Unit Cost | Concrete Modeling Data | Concrete Unit Cost | Dropdown lists | References

Spreadsheets Available (link)



Q & A Session



Email:

Pramen.Shrestha@unlv.edu

Wrobert@spypondpartners.com

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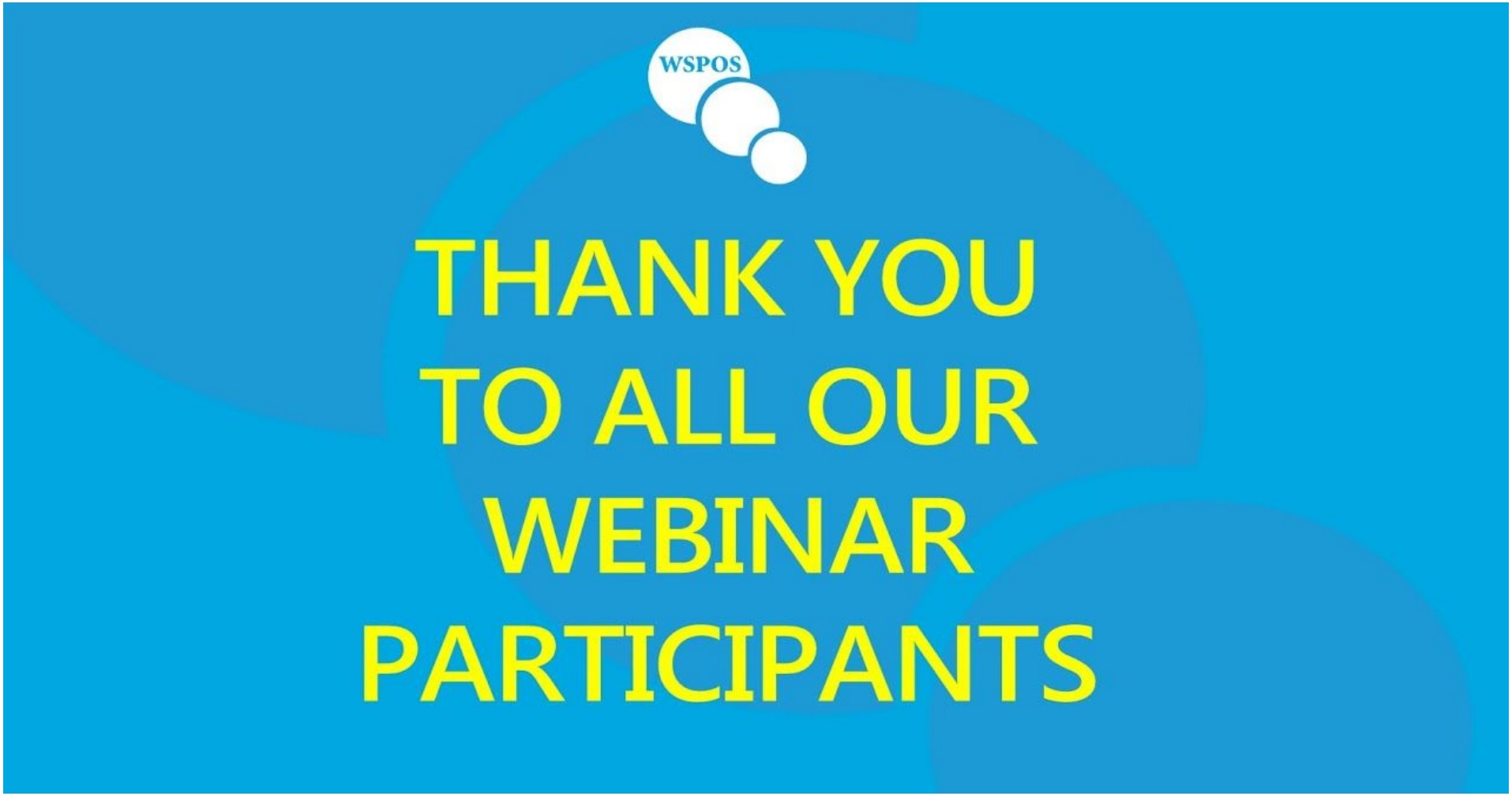

Pramen P. Shrestha, PhD, PE, F. ASCE
pramen.shrestha@unlv.edu
University of Nevada, Las Vegas

Bill Robert
wrobert@spypondpartners.com
Spy Pond Partners

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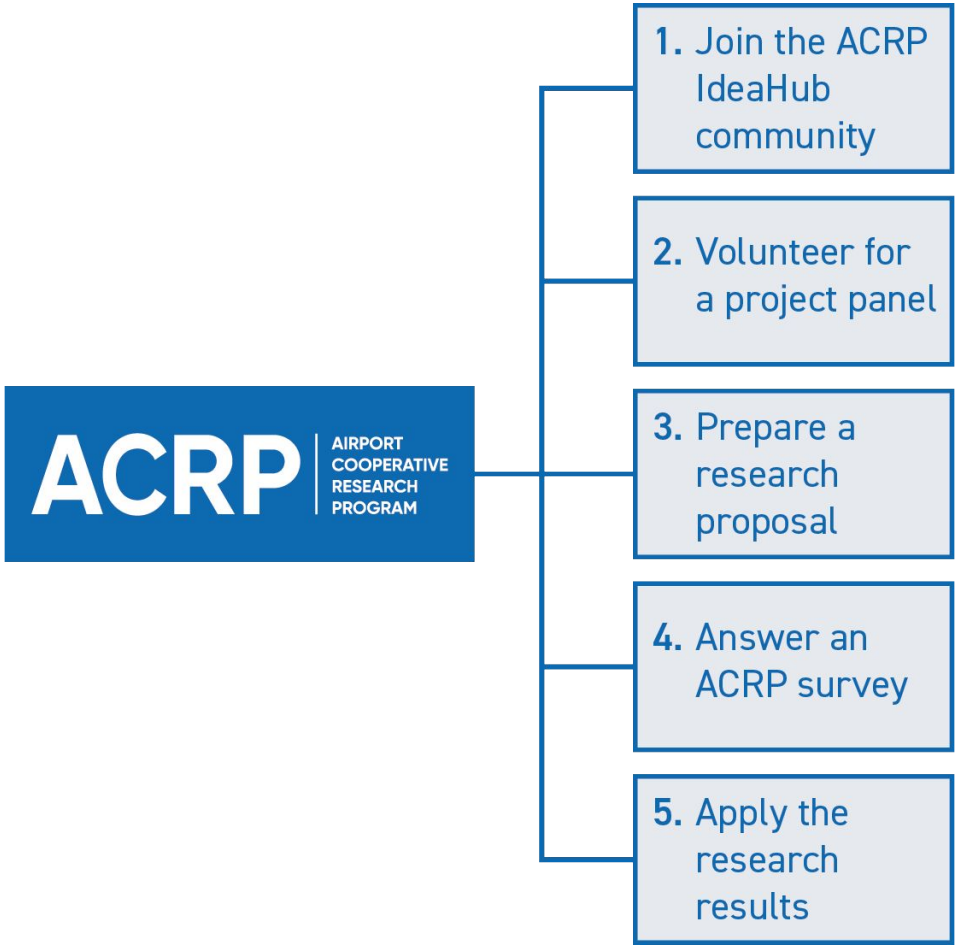

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