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Improving Airport Pavement Management Using An Analytical Hierarchy Process Decision Making Tool

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Outline of Presentation

- Introduction
- Scope and Objectives
- Pavement Texture/Rubber Accumulation
- Analysis of Results
- Findings and Impact
- Closing Thoughts

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Introduction

Introduction

- **BAT is a measurement mechanism which emulates the braking system of an aircraft on contaminated surfaces to provide predictive braking availability**
- **Determine if aircraft can safely land / take off from contaminated runway.**

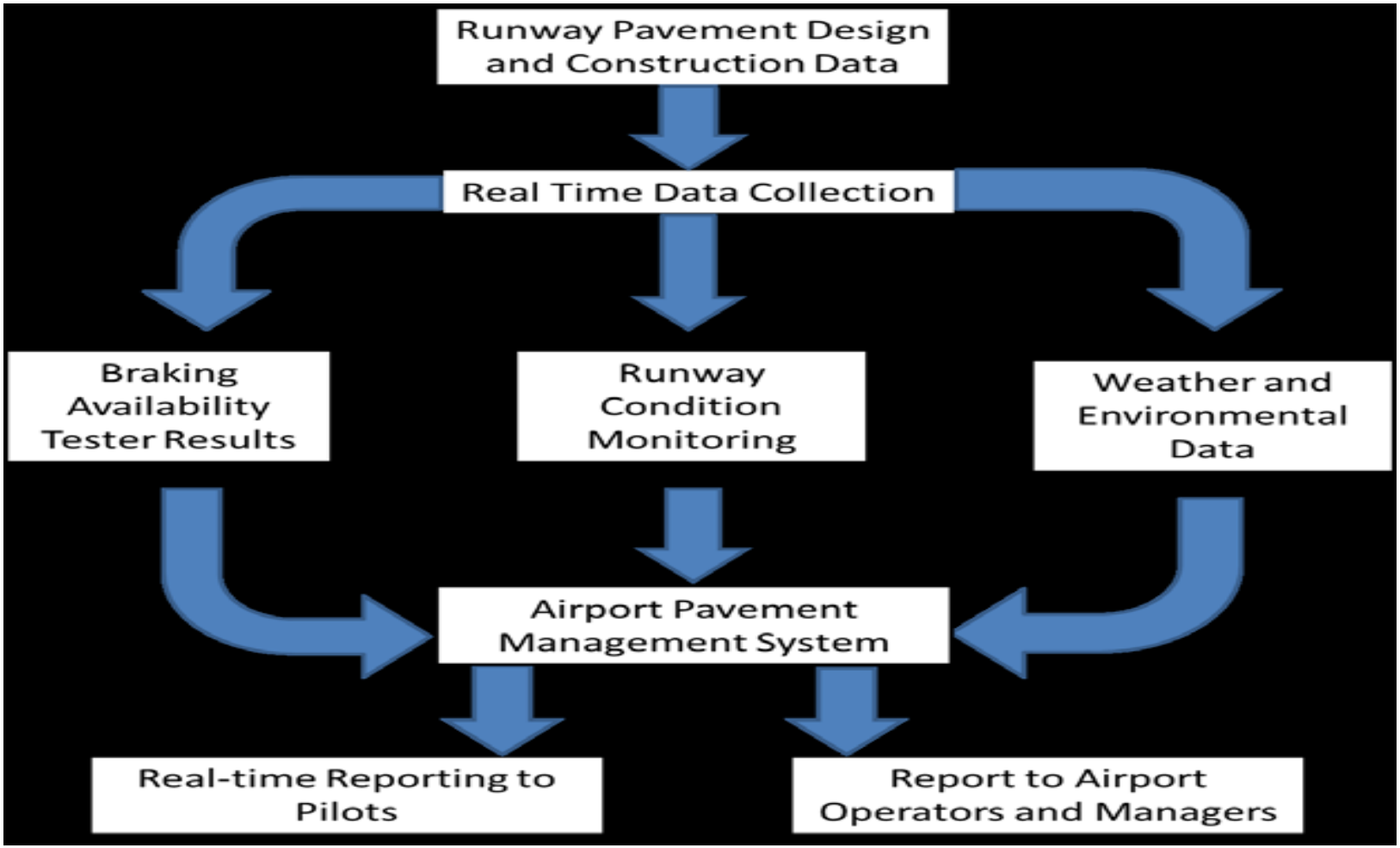
Introduction

- **APMS can incorporate various types of data to improve pavement analysis**
- **Airport Pavement Management System (APMS) considers all pavement assets**
- **Airport operators identify maintenance needs, prioritize treatments**
- **APMS incorporates asset deterioration modeling to justify performing treatments.**

Introduction

- **High level of service on runways means high quality pavement surface.**
- **Pavement texture and contaminant removal are crucial to ensuring safe aircraft landings/takeoffs.**
- **Pavement texture important for aircrafts landing in cold climates as snow and ice decrease runway friction and braking effectiveness.**
- **Rubber accumulation creates slippery conditions for aircrafts and precludes pavement drainage, increasing the risk of aircrafts hydroplaning.**

Scope and Objectives



Scope and Objectives

- **Analytical Hierarchy Process (AHP) as a tool that can be incorporated into an APMS to rank alternatives and provide justification for the recommended option.**
- **Case study for maintaining runway friction with various rubber removal procedures is included to illustrate how to apply an AHP.**
- **Practical aspects of incorporating an AHP in an APMS.**

Why is the Research Important?

Pavement Texture

- **Helps aircrafts safely maneuver the runway and provides a landing aircraft with the traction required to safely stop.**
- **Very important in wet and cold weather climates when runway contaminants impact the braking availability.**
- **Microtexture and macrotexture are two factors that contribute to pavement friction.**

Pavement Texture

- **Aircrafts safely maneuver the runway and provides a landing aircraft with the traction required to safely stop.**
- **Important wet and cold weather climates where runway surface contaminants impact the braking availability.**
- **Pavement microtexture and macrotexture are two factors that contribute to pavement friction.**

Pavement Texture

- **Surface effects the rate at which rubber accumulates on the runway.**
- **Coarse surface will accumulate rubber faster.**
- **Increased risk to hydroplane with rubber.**

Rubber Accumulation

- **Aircraft tires are made from soft, load absorbing rubber.**
- **Heat and friction generated during landing causes the rubber to polymerize, forming a hard, dense rubber that stays on the runway.**
- **Typical aircraft landing deposits approximately 700 g of rubber on the runway.**
- **Majority of this rubber accumulates within 300 m of the touchdown area.**
- **Runway is dry, the interaction between rubber on the runway and the tires actually leads to increased traction.**

Rubber Accumulation

- **Runway is wet, the rubber accumulation creates a slick surface for landing aircrafts which significantly decreases the overall runway friction.**
- **Loss in friction poses a safety threat for aircrafts landing during inclement weather conditions.**
- **Rubber accumulation clogs drainage channels in the pavement macrotexture, preventing water from draining off the runway.**

Scope and Objectives

- **Analytical Hierarchy Process (AHP) as a tool that can be incorporated into an APMS to rank alternatives and provide justification for the recommended option.**
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Analysis of Results

- **Waterblasting: Rubber removal process that entails using a high pressure spray of water.**

Analysis of Results

- **Shotblasting: Process that uses an abrasive material to blast rubber off runway pavement surface.**

Analysis of Results

- **Chemical Removal: Chemical compound to soften and decompose the rubber so it can be gently removed by a broom or vacuum.**

Analysis of Results

- **Mechanical Removal: Scraping, grinding, milling or sandblasting to remove rubber buildup.**

Analysis of Results

- **AHP: Develop a tool to help airport operators determine which rubber removal technique is most appropriate for their airport.**
- **AHP: Variety of criteria (and the option for adding site specific criteria) that are possible factors in the decision making process.**
- **AHP: Prioritizing competing projects for funding allocation, selecting pavement maintenance techniques for a particular section of the network and selecting a contractor from a group of competitive bids to complete repair work.**

Analysis of Results

- **AHP: Airport operator assigns a weight between 0% and 100% to each of the criteria being evaluated.**
- **Cost of the operation**
- **Effects on the pavement structure**
- **Availability of highly skilled operations staff**
- **Contracting mechanisms**
- **Environmental sensitivity**
- **Emergency landings**
- **Access to other runways**

Analysis of Results

- **High criteria weight assigned to important criteria.**
- **Mid-volume airport: Cost of the operation and the effects on the pavement structure are the most important criteria for rubber removal.**
- **Airport has a small but highly skilled operations staff that is quite flexible in a variety of maintenance roles, the airport is also comfortable contracting work out if necessary.**

Analysis of Results

- **Airport is not located in an environmentally sensitive area, and is primarily surrounded by undeveloped industrially zoned lots.**
- **Airport views accommodating an unscheduled emergency landing as a low probability event**
- **No secondary runway that could accommodate an emergency landing.**
- **Result: Waterblasting, Mechanical, Shotblasting and Chemical.**

Analysis of Results

- **Midsized airport might prioritize the cost and pavement elements over other factors.**
- **Low volume/remotely located airport: start-up cost of the operation, availability of skilled workers and availability of equipment and materials.**
- **Military airport: emergency landings, rate the ability to reopen the runway as a very important factor.**
- **Selection of the preferred alternative depends on the criteria selected and the weights assigned as well as the corresponding score assigned to each alternative.**

Analysis of Results

- **Using AHP in an APMS is that it creates opportunity for strategic planning. W**
- **Absence of APMS, airport operators are likely to make project funding decisions that optimize the annual capital budget.**
- **AHP allows for additional factors to be incorporated.**
- **Can be incorporated into an APMS to help identify priorities by ranking and comparing alternatives.**

Findings and Impact

- **Airport operators can use an APMS to determine which pavement sections require maintenance treatments.**
- **APMS used to provide justification for project funding and prioritization.**
- **AHP can be used for comparing several competing alternatives by using weighted scores assigned to several factors that can be considered in the decision making process.**
- **Qualitative and quantitative variables incorporated in the decision making process, and the results can be presented to stakeholders as justification for selecting the preferred alternative.**

Closing Thoughts

- **After AHP focus on selecting rubber removal techniques is to expand the scope of how AHPs can be used to make decisions in an APMS.**
- **AHPs can be expanded to compare and rank maintenance treatments for a specific project, or to compare competing projects to determine which project should receive funding.**
- **Process of developing an APMS and implementing AHPs within the system must be iterative.**

Closing Thoughts

- **Data collection must be ongoing to ensure the decisions made by the APMS are based on the most recent data, standards and work practices.**
- **Data collection becomes accessible and adopted by the aviation industry, it should be assessed and incorporated into the APMS if relevant.**
- **Airport operators and maintenance staff must be continually trained on how to perform data collection and analysis to ensure consistency of results.**

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