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

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Outline of Presentation

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• Pavement Texture/Rubber Accumulation
• Analysis of Results
• Findings and Impact
• Closing Thoughts
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

- Runway Pavement Design and Construction Data
- Real Time Data Collection
- Braking Availability Tester Results
- Runway Condition Monitoring
- Weather and Environmental Data
- Airport Pavement Management System
- Real-time Reporting to Pilots
- Report to Airport Operators and Managers
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.
• 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.

• 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.
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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