Summary of Climate Change and Airfield Pavements Survey

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Heidi Vanheule, Donghui Lu, Drew Dutton, Susan Tighe

Centre for Pavement and Transportation Technology

Department of Civil and Environmental Engineering

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Overview

- Background CPATT
- Introduction
- Previous CPATT Projects
- Survey Objective
- Summary of Survey Results
- Conclusions and Next Steps

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Background CPATT

- CPATT's initiative involves an integrated program of field and laboratory research.
- Focus on emerging and innovative technologies.
- State-of-the-art research infrastructure.
- Increase in the talent pool of HQP.
- Sustained partnerships.
- Provide national and international leadership.

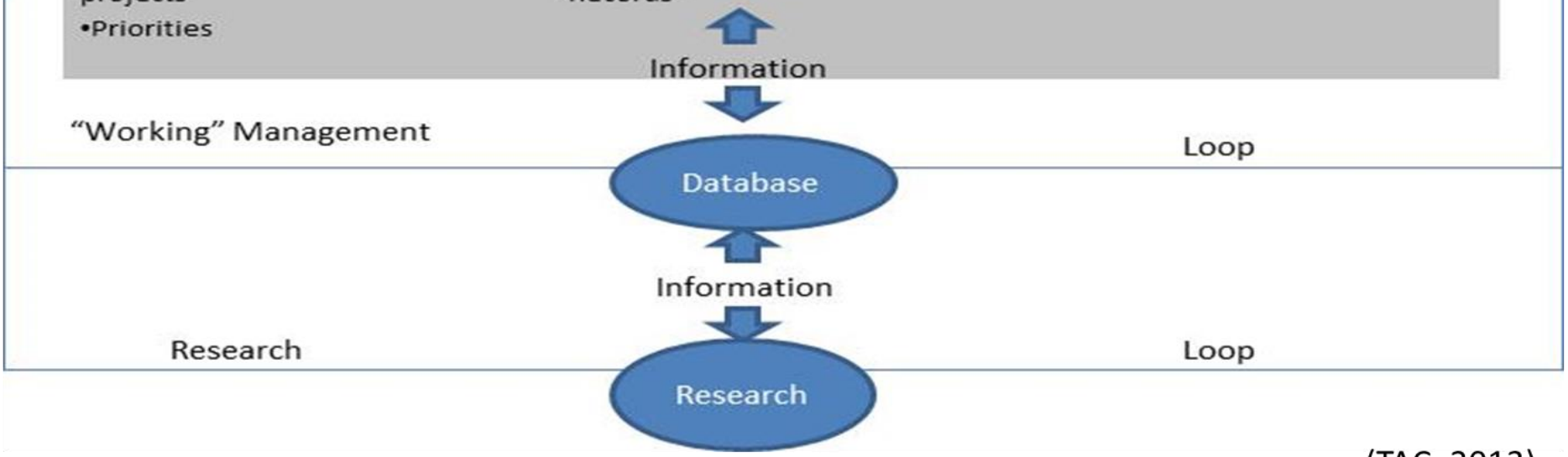
CPATT Values

- Commitment to high quality research that advances theory and contributes to engineering practice or policy development.
- Foster a community that promotes research and development of students, faculty and partners.
- Support multidisciplinary and interdisciplinary research.
- Facilitate commitment to making research findings and their implications available in formats that target the needs of different audiences.
- Be responsive to research needs.

Key Theme Areas

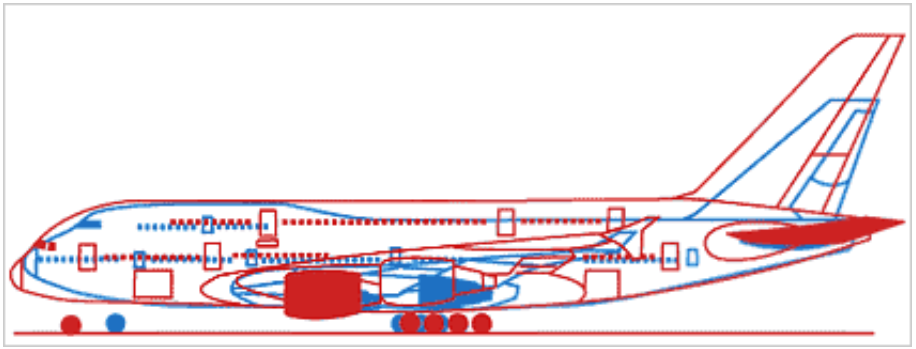
- Climate Change Impacts on Infrastructure
- Sustainability Incorporated into Design, Construction, Maintenance, Management
- Investment balances: Preservation and Expansion
- Allocate Budgets: Satisfy Organization Needs, Customer Requirements, Meet Performance Expectations

Planning and Programming	Design	Construction	Maintenance, Preservation and Rehabilitation	In-Service Evaluation	End of Service Life
•Traffic and Environmental data information •Assess network deficiencies •Budgets •Establish priorities •Schedule projects •Priorities	•Information on materials, traffic, costs, environment, etc. •Design alternatives •Analysis •Optimization •Sustainability •User costs	•Environment during construction •Specifications •Contracts •Schedules •Construction operations •Quality control/quality assurance •Records	•Standards •Treatments •Schedules •Operations •Budget control •Records •Impact on performance •User costs	•Periodic monitoring of structural adequacy, roughness, surface distress, and surface friction •Assess performance •Prioritize	•Recycling and reuse of materials for reconstruction •Salvage Value •Records •Restoration •Zero Waste Management



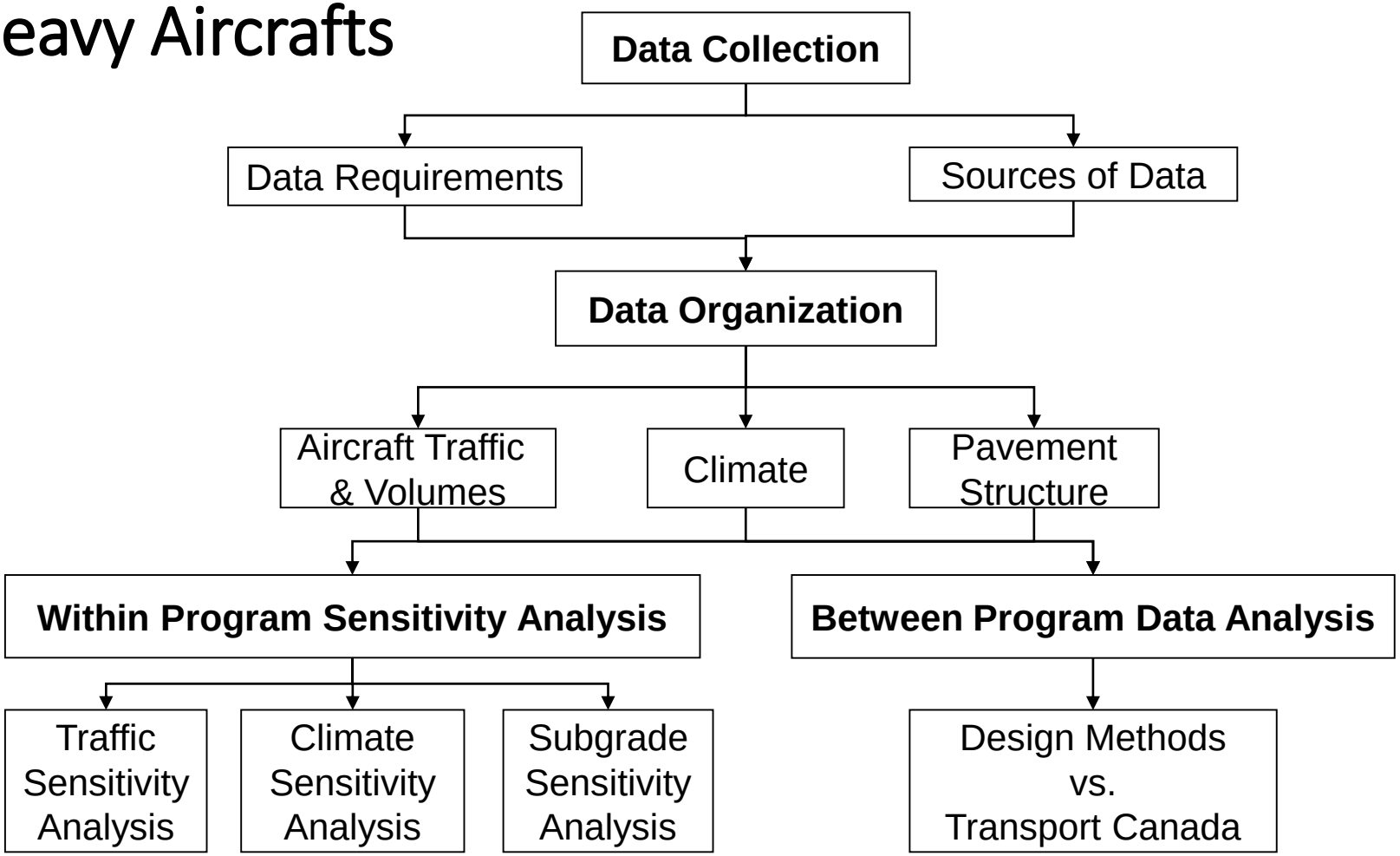
(TAC, 2013)

Heavy Aircrafts



Whiteley

Heavy Aircrafts



Whiteley

Smith

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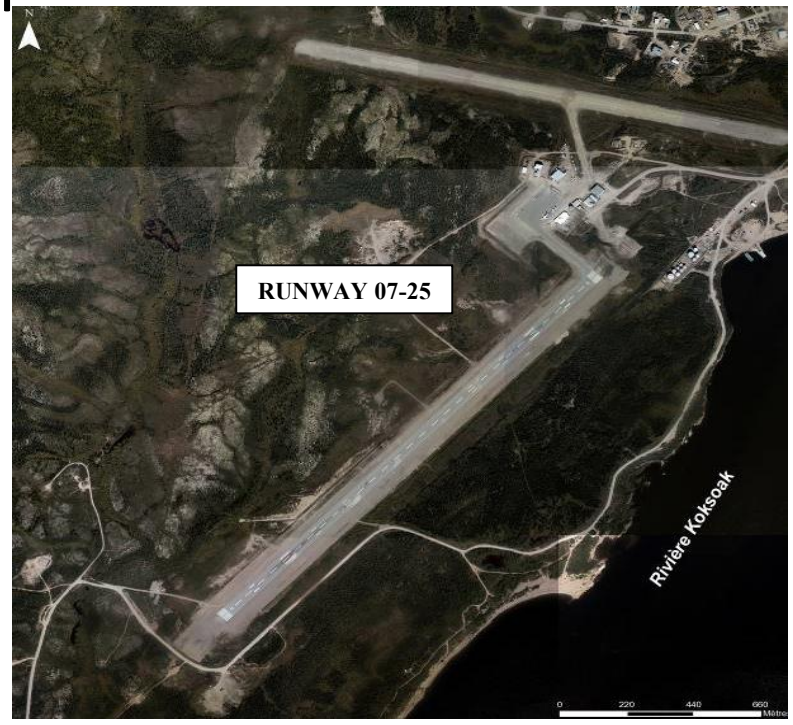
Effect of Rubber Buildup

Pinto

Northern Canadian Airport

- Effects of Climate Change on the Runway 07-25
- Located above 58th parallel, southern limit of discontinuous permafrost distribution



Konarski

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Northern Canadian Airport

Brooming Equipment

Field Site Visit 2012 Konarski

Northern Canadian Airport

- Airport had safety concerns with runway surface friction and frequent amount of required winter maintenance
- Extensive friction/texture field testing program and analysis required to help in development of a cost effective friction restoration treatment

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Northern Canadian Airport

- Fluctuations in ambient temperatures, Increased precipitation levels
- Ice cover diminishing on River, fog generation
- Fog condenses and freezes on runway
- Augmented requirement for winter maintenance activities (chemical and mechanical)

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Northern Canadian Airport

- Increased winter maintenance (brooming) result in decreases in microtexture and friction, and increases in macrotexture
- Runway experiencing excessive bumps due to differential frost heave. The bumps were occurring as a result of non-uniformity in the frozen ground

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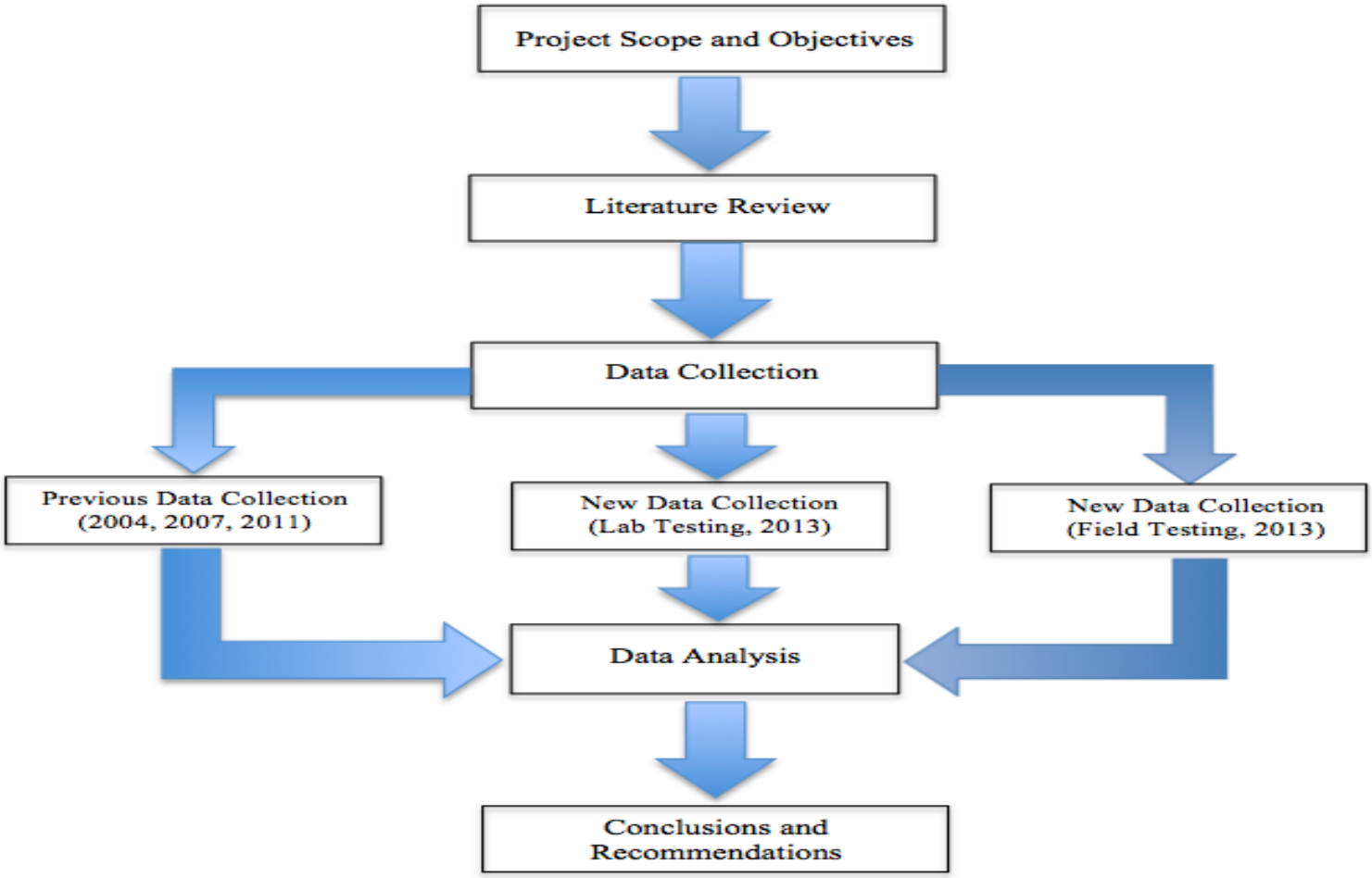
Northern Canadian Airport



Northern Canadian Airport

- Laboratory Testing
  - Extraction and Gradation
  - Bulk Relative Density
  - Maximum Relative Density
  - Air Voids
  - Flow
  - Stability
  - Voids in Mineral Aggregate
  - In-situ Pavement Compaction Determination
  - PGAC Classification
  - British Pendulum Testing

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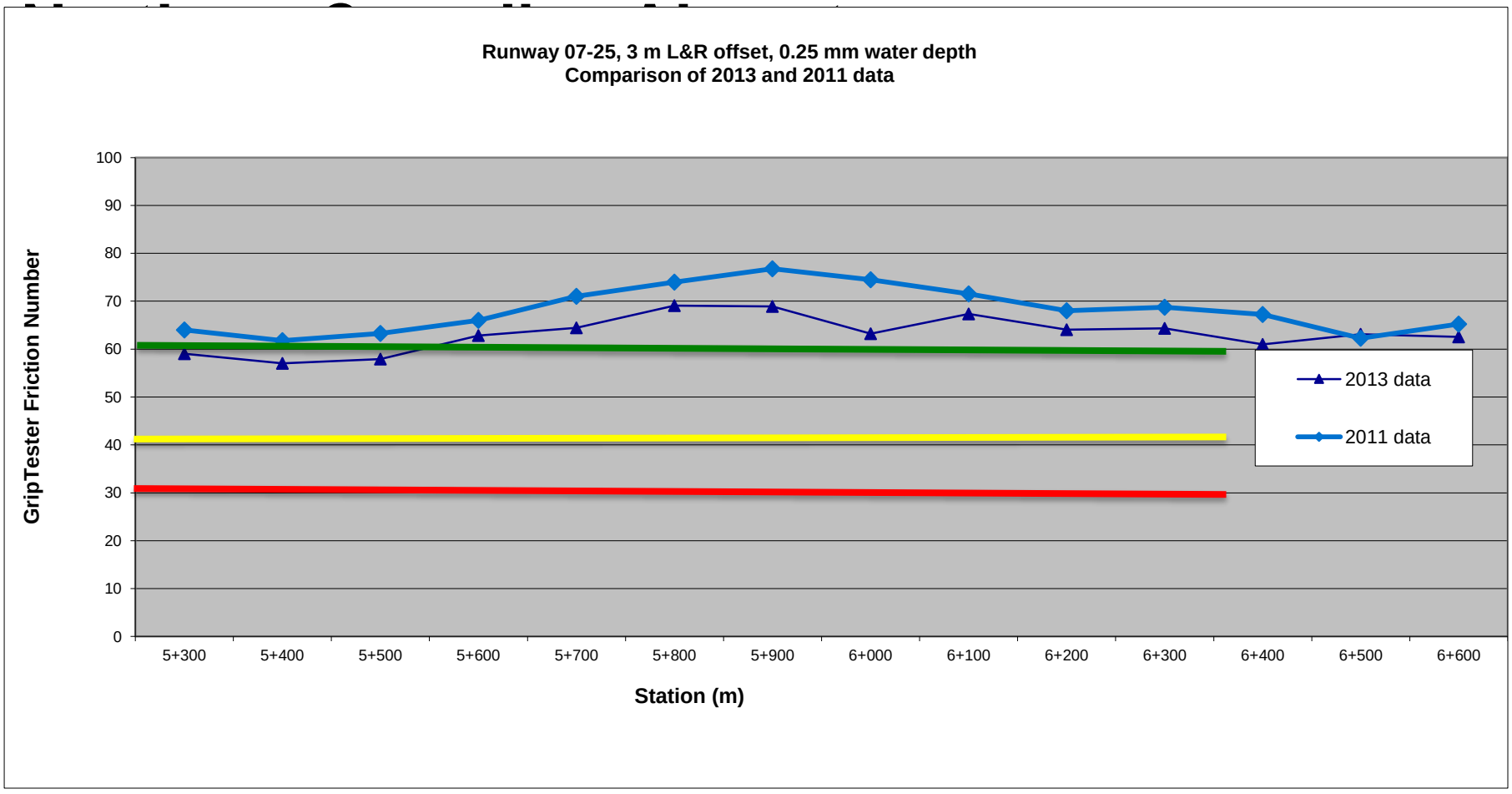
Northern Canadian Airport


Runway 07-25, 3 m L&R offset, 0.25 mm water depth
Comparison of 2013 and 2011 data
GripTester Friction Number
100
90
80
70
60
50
40
30
20
10
0
5+300
5+400
5+500
5+600
5+700
5+800
5+900
6+000
6+100
6+200
6+300
6+400
6+500
6+600
Station (m)
2013 data
2011 data

Background Information

- Airport had safety concerns with runway surface friction and frequent amount of required winter maintenance
- Extensive friction/texture field testing program and analysis required to help in development of a cost effective friction restoration treatment

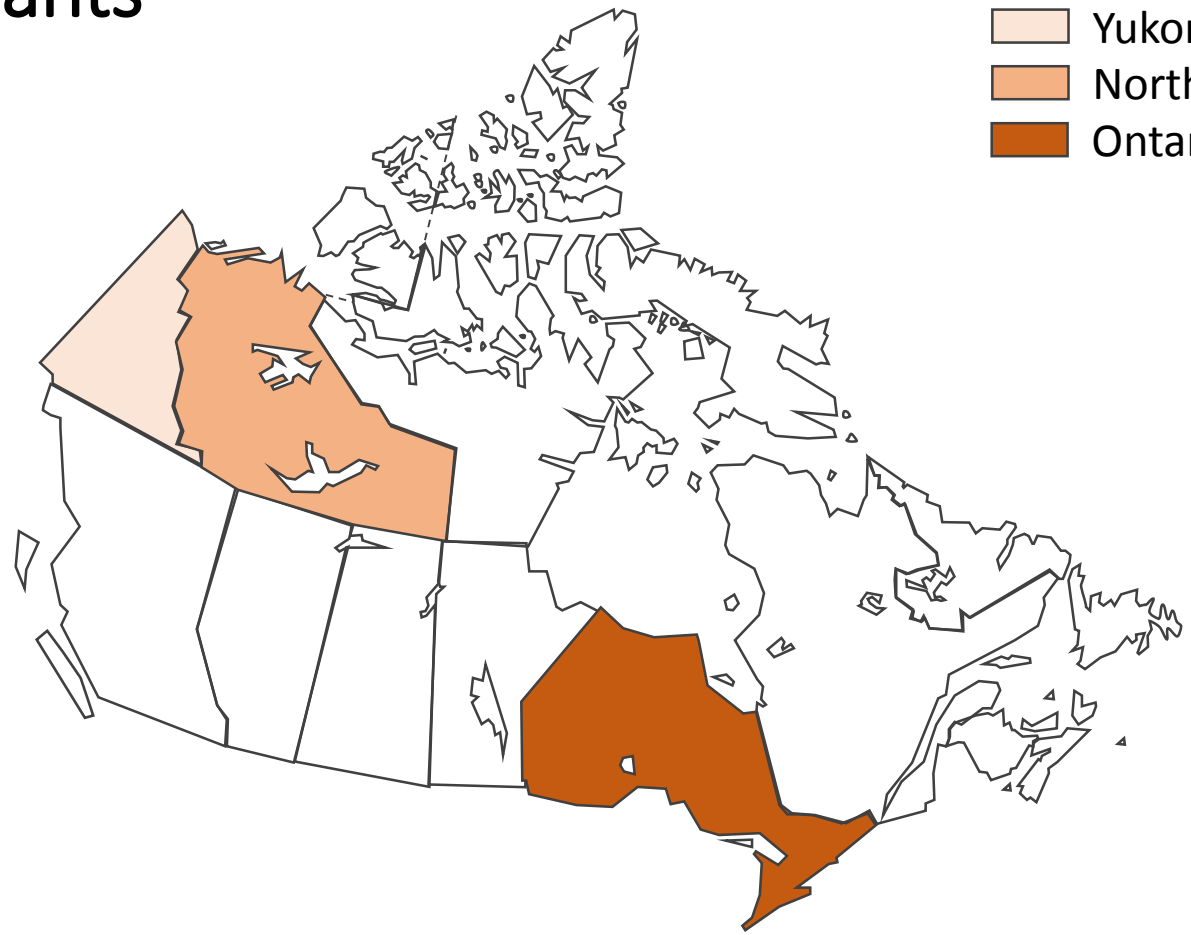
Background Information

- Students at the University of Waterloo created a survey in order to assess the impacts of climate change on the mitigation and adaption strategies used by airport authorities in the maintenance, rehabilitation, and preservation of airfield pavements.
- The survey was distributed to airport authorities online via survey monkey.

Survey Objectives

- Determine the current awareness of climate change
- Adverse effects due to climate change, current practices used to mitigate and adapt to these adverse effects
- Determine climate change risk consideration in pavement maintenance, rehabilitation, and preservation strategies with respect to extreme precipitation and flooding, extreme temperatures, and permafrost
- Identify future considerations with respect to adaptation and mitigation strategies

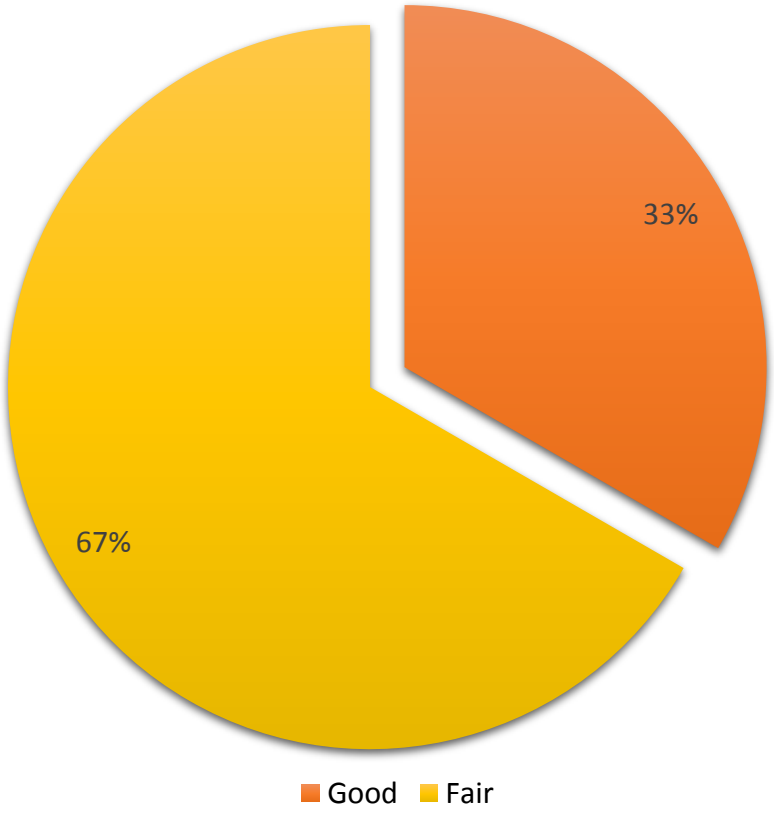
Participants



Pavement Types

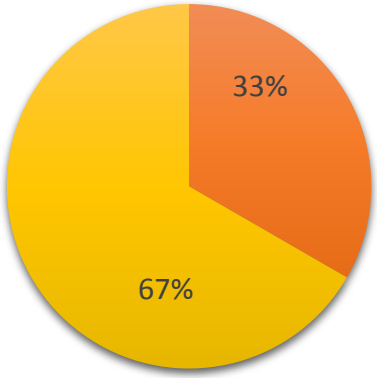
Pavement Type	Runway			Taxiway			Apron		
	Yukon	NW Territories	Ontario	Yukon	NW Territories	Ontario	Yukon	NW Territories	Ontario
Asphalt Concrete	X	X	X	X	X	X	X	X	X
Portland Cement Concrete			X	X		X	X		X
Composite			X			X			
Gravel		X		X	X			X	

Current Airfield Pavement Conditions

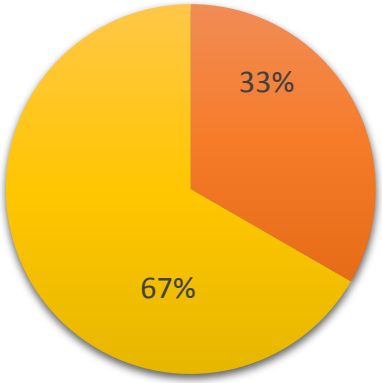


Perceived Impacts of Climate Change

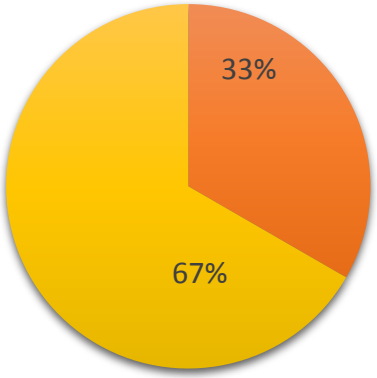
Frequency of Extreme Precipitation



Intensity of Precipitation



Number of Freeze-Thaw Cycles



Significantly Increased Slightly Increased

Frequency of extreme precipitation and intensity of precipitation, Northwest Territories and Yukon have seen a slight increase while Ontario has seen a significant increase. With respect to the number of freeze-thaw cycles, Ontario and Yukon have seen a slight increase while Northwest Territories have seen a significant increase.

Perceived Major Climate Change Challenges

- Yukon
  - Freeze-thaw cycles
- Northwest Territories
  - Freeze-thaw cycles
  - Thawing permafrost
- Ontario
  - Maximum temperature
  - Increased Flooding
  - Wind intensity

Change in Pavement Maintenance, Rehabilitation, and Preservation Practices in the Past 10 yrs

- Yukon
  - No Change
- Northwest Territories
  - More Deicing
  - More Snow Removal
  - More Grooving
  - More Crack Sealing
- Ontario
  - Less Deicing, Less Snow Removal

Climate Change Consequences on Airfield Pavement

- **Raveling**
- **Rutting**
- **Shoving**

→ Prominent Consequences

- Early cracking
- Crack severity
- Settlement
- Pumping
- Soft spots
- Heaving

Impacts of Changing Climate

- All participants consider climate change in pavement management decisions to some degree.
- All participants have implemented mitigation strategies for preserving airfield pavements.
- Participants have not assessed the risk of climate change on vulnerability of pavements when exposed to extreme weather.

Tools and Techniques Currently Used to Respond to the Impacts of a Changing Climate

- **Review and adopt best practices**
- Increase the magnitude of design parameters or safety factors
- Consider replacing existing practices with entirely new solutions

Tools and Techniques Currently Used to Respond to the Impacts of a Changing Climate

- Perform risk assessment, identify infrastructure at risk, and retrofit priority assets
- Consider increased deterioration rates in design and maintenance plans
- Design infrastructure that can be modified over time as the impacts of a changing climate occur

Main Barriers to Consider Climate Change Risk and Adaptation or Mitigation

- **Insufficient funds**
- Lack of related research
- Lack of technology and design alternative
- Lack of adequate climate data
- Lack of adequate climate data analysis
- Lack of requirements in codes, standards, or policy
- Lack of available time

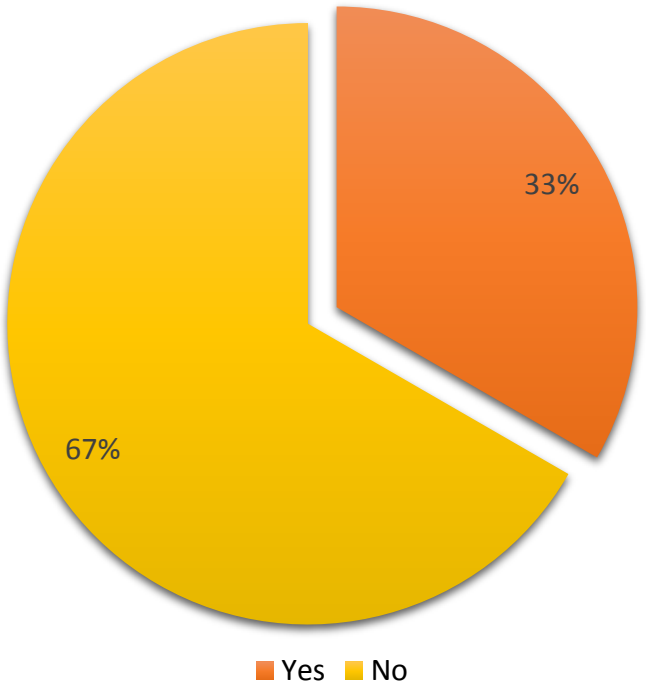
Best way to Adapt to Climate Change Risk

- **Funding**
- **Technology and Design**
- **Adaptation/Mitigation and Planning**
- Research
- Climate Projection
- Risk Assessment

Flooding due to Climate Change

- Participants did not plan on purchasing flooding risk coverage for airfield pavements.
- Participants agreed that the drainage system should be upgraded in the **short term** for future flooding.
- Participants strongly agreed that the drainage system should be upgraded in the **long term** for future flooding.

Observed Increase in Sustained High Temperatures in the Past 10 Years



Effects of high temperatures on operations and/or maintenance for pavements include ice-jacking.

Northwest Territories and Yukon have seen an increase in sustained high temperatures in the past 10 years while Ontario has not.

Changes to Pavements as a Result of High Temperatures

- Asphalt concrete binder type
- Base type
- Base thickness

Permafrost Active Layer Depth

- Northwest Territories has airports built on permafrost.
- Noted **increase** in permafrost active layer depth.
- Frequency and/or severity of permafrost related damage to pavements is expected to increase.

Conclusions

- Increase in frequency extreme precipitation, intensity precipitation and number of freeze-thaw cycles have been observed in the last 10 years.
- Major climate change challenges include increased freeze-thaw cycles, thawing permafrost, maximum temperature, flooding, and windspeed intensity.

Conclusions

- Predominately an increase in raveling, rutting, and shoving has resulted from a changing climate.
- Mitigation strategies for preserving airfield pavements has been considered
- Risk of climate change means vulnerability of pavements when exposed to extreme weather has not been assessed.

Conclusions

- Experimental Design in Airport Engineering Research Important
- Educating Future Leaders in Airport Engineering
- Tie Research into Management Applications
- Work with Industry to Facilitate Technology Transfer
- Examine Climate Change, Adoption of New Materials and Designs

Recommendations

- Assess the risk of climate change on vulnerability of pavements when exposed to extreme weather.
- Upgrade drainage systems for short and long term flooding.
- Continue to collect data on how a changing climate affects airfield pavements.
- Increase funding for climate change research and mitigation/adaptation strategies.

Acknowledgements

- Undergraduate and Graduate Students, CPATT Partners
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- Transport Canada
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- Ontario Hot Mix Producers Association (OHMPA)
- Cement Association of Canada
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ohmpa
Ontario Hot Mix

Cement Association of Canada
Association Canadienne du Ciment

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Ontario

NSERC CRSNG

We Need Your Help: Complete our Survey

https://www.surveymonkey.com/r/Airfieldpavements

40 hard copies

Sheet to complete later email addresses

sltighe@uwaterloo.ca

donghui.lu@uwaterloo.ca