ACRP Problem Statement: 55 **Recommended Allocation:** $300,000

Green Taxiing at Airports

Click here to see problem statement in IdeaHub: **http://ideascale.com/t/UKsrZBS7W** *(Note: you must be a registered user in myACRP/IdeaHub.)*

TAGS: Airport Planning, Airside, Design, Environment, Finance Economics, Noise Impacts, Operations, Policy, Safety, Sustainability

STAFF COMMENTS

This problem statement has been submitted previously. It would need to consider the results of ACRP Report 158: Deriving Benefits from Alternative Aircraft-Taxi Systems and RRD 15: Use of Towbarless Tractors at Airports.

AVERAGE INDUSTRY RATING SUMMARY

	Committees[1]	**Airport Community[2]**
Achievable	3.40	3.79
Applicable	3.40	4.20
Implementable	3.20	3.79
Understandable	3.80	4.07
OVERALL	3.45	3.94

Notes: 1. Includes TRB aviation committees and committees from ACI-NA and AAAE.
2. Includes airport employees serving on active ACRP project panels.

USE THIS LINK TO SEE DETAILED INDUSTRY RATINGS. Click on the arrow in the Problem Statements dropdown menu in the upper right and select the problem statement number.

USE THIS LINK TO SEE DETAILED INDUSTRY COMMENTS. Click on the arrow in the Problem Statements dropdown menu in the upper right and select the problem statement number.

ACRP OVERSIGHT COMMITTEE (AOC) DISPOSITION

The average AOC rating among its voting members was 2.8 on a scale of 1 to 5. The problem statement was not selected for ACRP funding and will be returned to the idea collection phase of ACRP's IdeaHub.

ACRP Problem Statement: 55

Green Taxiing at Airports

TAGS: Airport Planning, Airside, Design, Environment, Finance Economics, Noise Impacts, Operations, Policy, Safety, Sustainability

OBJECTIVE

The main objectives of this idea are providing the U.S. airport industry and their stakeholders (airlines, ATO, ground handling service providers, etc.) with the following:

- Overview of the green taxiing solutions and their typical concepts of operations,
- Impact of these systems on airport operations, planning and design,
- Benefits for the environmental footprint and guidance for integrating the deployment of these technologies into noise/gas emission modelling and airport environmental policies.

The research project includes producing or collecting:

- An inventory of the existing and prospective green taxiing solutions,
- An evaluation of the impacts on planning and design,
- An evaluation of the impacts on ground and airport operations and safety,
- A preliminary compliance assessment of the technologies and concept of operations with the U.S. and local standards and regulations on design and operations,
- An evaluation of the benefits of these solutions on the environmental footprint of the airport,
- Guidance for integrating the deployment of these technologies into noise/gas emission modelling and airport "green policies".

The final deliverable shall include:

- A guidebook.

BACKGROUND

Since a recent past, policies have been implemented or strengthened in the United States, locally and nationwide, for mitigating noise, enhancing air quality, and more recently controlling greenhouse gas emissions. Air transportation is not excluded from these regulatory efforts, as shown by the environmental dimension of the Vision 100–Century of Aviation Reauthorization Act or the aviation part of the most recent amendments of the Clean Air Act.

One of the source of hazardous gas, greenhouse gas and noise at airports is the aircraft taxiing from the stand to the threshold. The landing and takeoff cycles represent about one fourth of the total airport emissions (Kesign, 2006). Taxi operations are the largest source of this fourth (Perl et al., 1997).

Taxiing is responsible for up to 4% of the total fuel consumption on a short or medium haul flight. Fuel burn during taxiing costs around 7 billion USD and produces about 18 million tons of CO_2 per year (Airbus, 2009). The industry responded to the challenge of fuel burn and noise reduction during taxing by developing innovative solutions for reducing the use of aircraft engines.

APPROACH TO RESEARCH

While aircraft landing and takeoff cycles account for about one fourth of the total airport emissions (Kesign, 2006), taxi operations are the largest source of this fourth (Perl et al., 1997). Taxiing is responsible for up to 4% of the total

fuel consumption on a short or medium haul flight. Fuel burn during taxiing costs around 7 billion USD and produces about 18 million tons of CO2 per year (Airbus, 2009). Aircraft taxiing engines on are also a source of noise.
The industry has developed solutions for reducing consumption during taxiing:

- Single-/Twin-Engine Taxiing: multi-engine aircraft taxi with one or more engine off. Other engines provide the thrust required for keeping the aircraft in movement. These procedures are widely used by aircraft operators all over the world, and they reduce engine maintenance expenses and fuel consumption (about 4 kg/min. for an A320 according to the 2016 European Aviation Environmental Report). Also, it lowers the noise and gas emissions generated by the aircraft. However, these procedures are not possible when the taxi-in/-out times are short, and on taxiways with significant slopes. Also, they might generate more jet blast as suggested by the Aircraft Characteristics for Airport Planning (ACAP) document of the Boeing 737 MAX.

- Zero-Engine Taxiing: the industry developed or removing the need for thrust when taxiing. The existing systems and concepts can be divided in two families:

-- Built-in electric motors mounted on the nose wheel (e.g. WheelTug) or on the main gear (e.g. Safran/Honeywell EGTS). Only the APU is required for powering the electric motor.

-- Tractors: A tug is used for towing the aircraft from the stand to the threshold. The only existing off-the-shelf solution of this type is called TaxiBot (Airbus/IAI). This towbarless tractor is equipped with thermic/electric motors. After a classical pushback, the pilot takes the command of the tug and pilots it with the joystick/yokes to a designated disconnection area. No modification of the aircraft is required. TaxiBot is used on the daily basis at Frankfurt-Main (FRA) by Lufthansa (operated by LEOS).

These systems (that have not been in use in the U.S. air carriers for the moment) reduce the footprint of the airport when used by airlines. However, they are different in their advantages and externalities. For instance, built-in systems increase aircraft weight and so the consumption during flight – but have no or little impact on airport infrastructure. The tractor solution needs area of disconnections close to the thresholds and may requires vehicle service road upgrades in order to make them suitable for large tugs.

- Departure Manager (DMAN) and Surface Manager (SMAN):

-- A Departure Manager (DMAN) is a planning system to improve departure flows at airports by calculating the Target Take Off Time (TTOT) and Target [Engine] Start-up Approval Time (TSAT) for each flight, taking multiple constraints and preferences into. Off-Block Times (departure from the gate) are also computed based on average taxiout time. DMAN provides predictability from the gate to the threshold. Aircraft can be “held” at the gate until the last moment, and do not need any more to be queued at the threshold. In other words: the DMAN “delays” aircraft departure from the gate. Instead of waiting engines on at the threshold, they wait on their stands engines off, saving fuel and reducing emissions and noise. DMAN was used temporarily at SFO during runway constructions in order to optimize the throughput. DMAN has been widely deployed in Europe as part of the Airport Collaborative Decision Making (A-CDM). A-CDM has been identified as a next step for CDM in the United States by the FAA/Industry CDM Stakeholders Group (CSG).

-- A Surface Manager (SMAN) is an ATM tool that determines optimal surface movement plans (such as taxi route plans) involving the calculation and sequencing of movement events and optimizing of resource usage (e.g. de-icing facilities). In other words: given the average taxi times or taxi speeds throughout the airfield, the departure and arrival sequences, as well as the airfield capacity (especially airspace and runway capacities), a software solution determine for each aircraft the best routing from the threshold to the gate (and reciprocally) in order to optimize the throughput on the ground, minimize the taxi-in and taxi-out time, and reduce consumption. Advanced SMAN are paired with the Airfield Ground Lighting (AGL) in order to guide the aircraft in the field with a visual signal (taxiway centerline lights on/off a.k.a. “Follow-the-Green”).

FINAL OBJECTIVES

The final objectives of this research project are providing to U.S. airports and their stakeholders:

- Overview of the green taxiing solutions and their typical concept of operations;
- Impact of these systems on airport operations, planning and design;
- Benefits for the environmental footprint and best practices for integrating the deployment of these technologies into noise/gas emission modelling and airport environmental policies;

- Elements of decision making regarding the promotion, regulation or restriction of these green solutions when applicable.

PROPOSED TASKS

The research shall include:

- Topic A – Single-/Twin-Engine Taxiing

a) Description of the concept of operations of SET/TET.
b) Research on the extent of the application of these procedures in the U.S.
c) Evaluation of the safety impact of these procedures (cf. jet blast exposure).
d) Evaluation of the benefits of green taxiing on the environmental footprint of the airport.
e) Identification of best practices for integrating SET/TET in the airport environmental and safety policies.

- Topic B – Zero-Engine Taxiing

a) Inventory of the green taxiing solutions and the status of these projects.
b) Description of the concept of operations of these solutions.
c) Identification of their airport facility requirements when applicable.
d) Identification of the change in the training, procedures and operating conditions for each stakeholder: airport operator, ATCT, airline pilots, ground handling, etc.
e) Preliminary compliance assessment of the technologies and concept of operations with the U.S. standards and regulations.
f) Evaluation of the benefits of green taxiing on the environmental footprint of the airport.
g) Preliminary cost/benefit analysis for the stakeholders depending on the size and characteristics of the airport and its traffic.
h) Identification of best practices for integrating green taxiing in the airport sustainable policies.

- Topic C – Departure and Surface Managers (DMAN/SMAN) a)

Description of the concept of operations of these solutions.
b) Identification of the change in the training, procedures and operating conditions for each stakeholder: airport operator, ATCT, airline pilots, ground handling, etc.
c) Preliminary compliance assessment of the technologies and concept of operations with the U.S. standards and regulations – especially with the prerogatives of the FAA regarding ATM and flight programs.
d) Evaluation of the benefits of DMAN/SMAN on the environmental footprint of the airport.
e) Preliminary cost/benefit analysis for the stakeholders depending on the size and characteristics of the airport and its traffic.
f) Identification of best practices for integrating DMAN/SMAN in the airport environmental footprint and airport noise evaluation.
g) Benefits of integrated management approach (XMAN).

- Synthesis:

-- Overall impact of these systems on airport operations, planning and design;
-- Benefits for the environmental footprint and best practices for integrating the deployment of these technologies into noise/gas emission modelling and airport environmental policies;
-- Elements of decision making regarding the promotion, regulation or restriction of these green solutions when applicable.

DELIVERABLE

Final deliverable shall include:

- A report.

COST AND JUSTIFICATION

The estimated funding is $300,000.

The estimate research duration is 18 months.

RELATED RESEARCH

- ACRP Report 56 – Handbook for Considering Practical Greenhouse Gas Emission Reduction Strategies for Airports
- ACRP Report 57 – The Carbon Market: A Primer for Airports
- ACRP Report 71 – Guidance for Quantifying the Contribution of Airport Emissions to Local Air Quality
- ACRP Report 79 – Evaluating Airfield Capacity
- ACRP Report 84 – Guidebook for Preparing Airport Emissions Inventories for State Implementation Plans
- ACRP Report 96 – Apron Planning and Design Guidebook
- ACRP Report 137 – Guidebook for Advancing Collaborative Decision Making (CDM) at Airports
- ACRP Web-Only Document 09 – Enhanced Modeling of Aircraft Taxiway Noise, Volume 1: Scoping
- Le Bris, Methodology for Assessing Jet Blast Hazard on Airport Infrastructure and Operations, TRB 97th Annual Meeting, 2017
- Thomson et al., Analysis of Emissions Inventory for "Single-Engine Taxi-Out" Operations, George Mason University/Metron, 2014
- Phojanamongkolkij et al., Functional Analysis for an Integrated Capability of Arrival/Departure/Surface Management with Tactical Runway Management, NASA/TM–2014-218553, NASA, 2014
- Guo, Zhand and Wang, Operational Impact of Alternative Taxiing on Block Time and Relevant Airline Cost, University of South Florida, poster presented to the TRB 2015 Annual Meeting, 2014
- Deonandan and Balakrishnan, Evaluation of Strategies for Reducing Taxi-out Emissions at Airports, AIAA, 2010
- Deau, Gotteland and Durand, DSNA/DTI/R&D/POM, Airport surface management and runways scheduling, ATM2009

IDEA CREATOR

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OWNER/SUBMITTER

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