Green taxiing solution at Delhi Airport

By M. Muthukrishnan and Rekibuddin Ahmed (Delhi International Airport Limited – DIAL)

Climate change and Greenhouse Gas (GHG) emission management at Indira Gandhi International (IGI) Airport is one of the key sustainability aspects of Delhi International Airport Limited's (DIAL).

DIAL has embraced Airport Carbon Accreditation (ACA), the only framework helping airports globally to manage and reduce carbon emissions. In 2016 Delhi Airport became the first airport in the Asia Pacific region to achieve "Level 3+" and in 2020 DIAL achieved "Level 4+" as the first Airport in Asia Pacific and only the second Airport globally.

Delhi Airport is progressing strongly on environment and is committed to become a 'net zero carbon emission' airport by 2030. Towards this direction, DIAL has initiated various environmental sustainability programs. The measures identified by DIAL are- energy efficiency and conservation, green building programs, renewable energy, operational efficiency measures, airline programs, clean transportation, develop carbon sink and ACA. With these initiatives, DIAL is targeting to reduce scope 1 & 2 as well as scope 3 emission in the near future.

Background

The objective of the "airline program" is to work with airlines and other stakeholders to create opportunities and find solutions to reduce aircraft related ground emissions. As part of this initiative, DIAL promoted green taxiing "TaxiBots" usage at the Airport. TaxiBot[1] is the only operational alternative taxiing system that has been certified till now in the industry. Delhi Airport is the first airport globally to adopt commercial operation of Taxibot in 2019.

Green Taxiing Solution: TaxiBot

In a conventional aircraft taxi process, an aircraft is tugged by a ground vehicle to the Tug Disconnection Point (TDP). From the TDP, the aircraft starts its main engine and continues its Taxiing journey while burning precious Aviation Turbine Fuel (ATF) and emitting ground noise and ground carbon emissions before taking off from the runway. Use of TaxiBots eliminate the requirements of TDP and eliminates the requirements of switching on the main engine during the taxiing process. Figure 1 shows a comparison of conventional taxiing vs taxiing using TaxiBot.

In case of taxiing with TaxiBots, once the TaxiBot is attached to the aircraft, pushback operation and procedures are performed by the TaxiBot operator. After that, the control is taken over by the aircraft pilot. A patented TaxiBot-aircraft Nose Landing Gear (NLG) interface mechanism provides the pilot steering capability, using the airplane's existing controls in the cockpit. The TaxiBot system provides the pilot with the same handling characteristics as if taxiing with engines. It has unique NLG interface clamping mechanism (Figure 2) mounted on a "rotating turret" for:

- Load alleviation during pushback, acceleration, and braking
- Transferring pilot tiller steering commands to the tug wheels via a steering control system

In most cases, no modification to aircraft is required, and minor if any modifications to airports infrastructure are required. The pilot is always in control (after pushback) using airplane tiller and brake pedals (transparent to pilot as in regular taxiing). For braking purposes, the Main Landing Gear System is used and thus, there is no damage

1 The TaxiBot's are designed by Israel Aerospace Industries and manufactured by TLD of France. (https://www.taxibot-international.com/concept)

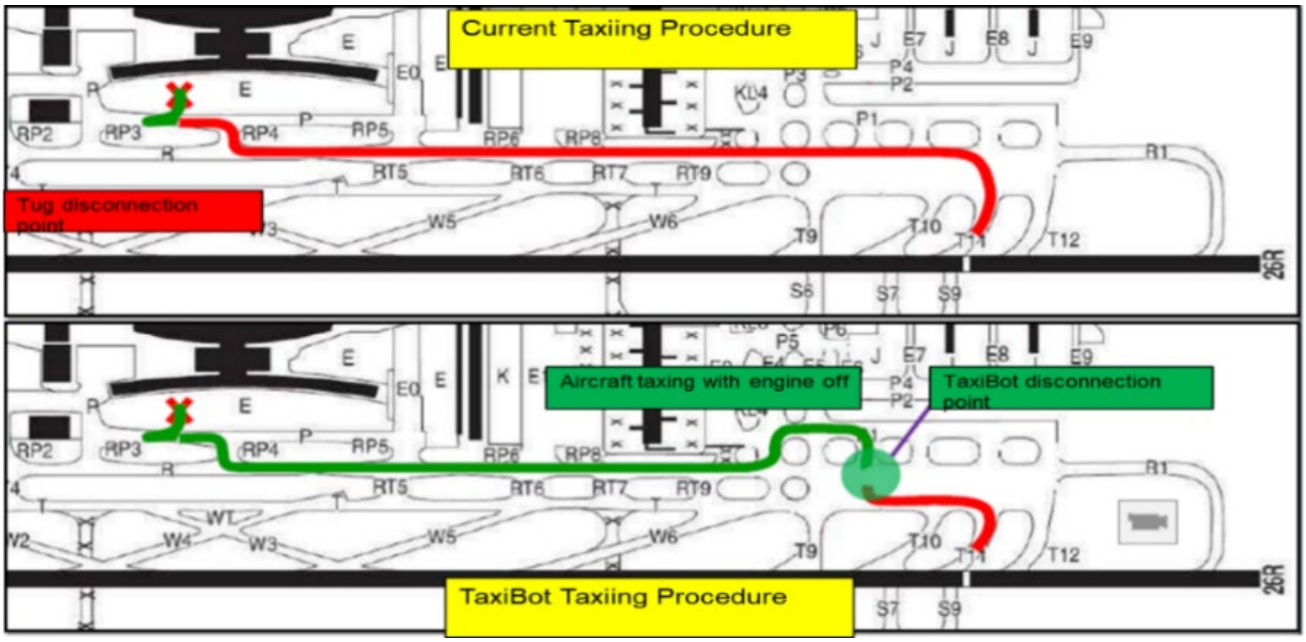

FIGURE 1: Comparison of conventional taxiing vs taxiing using TaxiBot

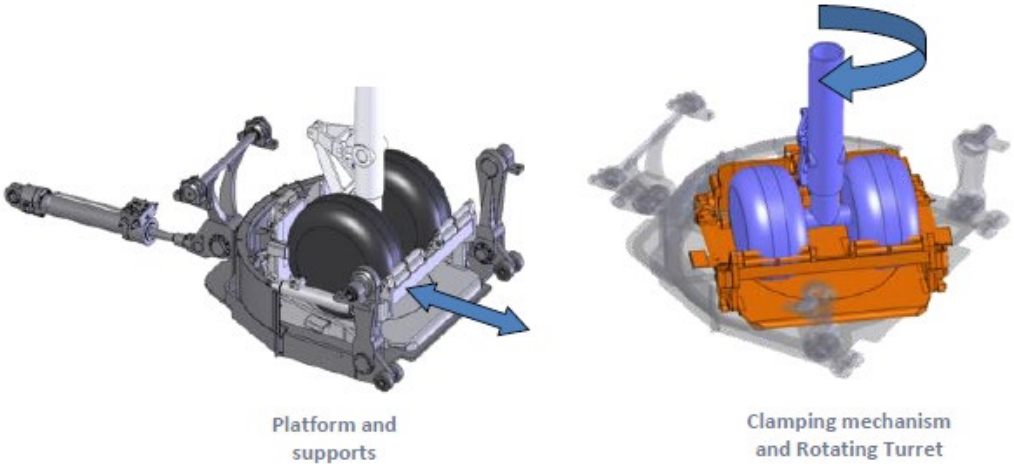

FIGURE 2: Nose Landing Gear (NLG) interface clamping mechanism

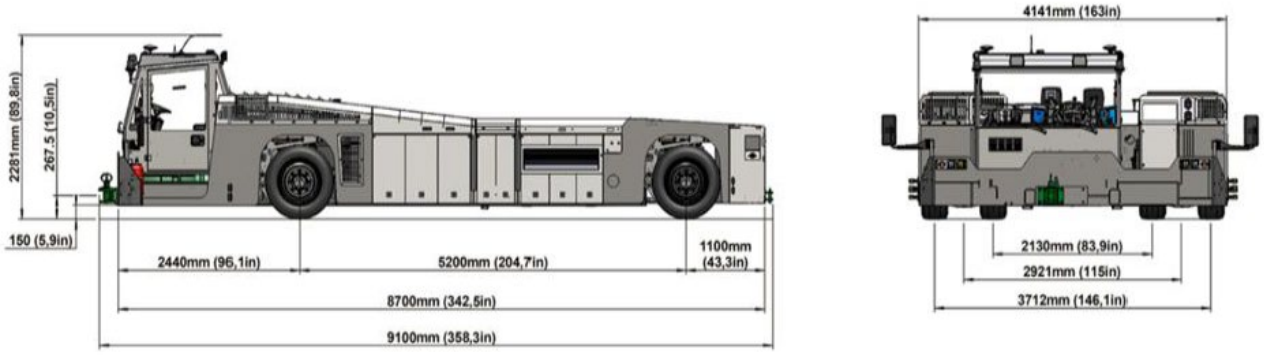

FIGURE 3: TaxiBot dimension

to the NLG of the aircraft because of the external load. With TaxiBots, aircraft can perform taxiing at 23 knots, same as current airplane ground taxi speed.

Once the aircraft reaches a pre-designated point on the taxiway, the aircraft stops and the TaxiBot is disconnected. It then returns to apron area and gets ready for its next operation. After TaxiBot disconnection, the aircraft will be ready for take-off as per Air Traffic Controllers (ATC) guidance. The list of complaint aircraft and TaxiBot dimensions are detailed below.

Compliant Aircraft

Boeing Aircraft Types	Airbus Aircraft Types
737-700	A318
737-800	A319
737-900	A320
737-900ER	A321
757-200 (only push back)	A320 (CEO & NEO Family)
757 – 200 F	A321 (CEO & NEO Family)
B737 – 8MAX	

Implementation

This project was delivered in three phases at IGI Airport which is shown in the Figure 3.

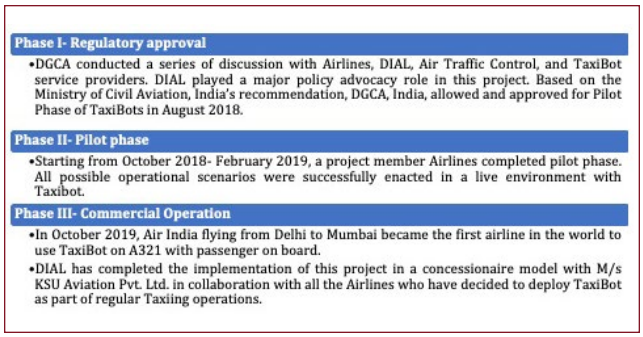

FIGURE 3: Three phases of implementation

Project Benefits

DIAL always strives to adopt newer technologies/best practices for enhancing operational excellence. The successful implementation of TaxiBot in Delhi Airport is an excellent case of technology adoption, stakeholder Engagement and innovation for pollution prevention. Key environmental benefits are:

- **Reduction in Fuel Consumption** - Use of TaxiBot ensures significant reduction in fuel consumption during aircraft taxiing. The fuel saving is a function of fuel flow rate during taxiing (kg/sec) and time taken during the taxing process (sec) and would also largely depend upon number of stop and turns and the amount of creeping traffic the aircraft encounters during ground taxiing. Currently the TaxiBots in Delhi Airport are compatible with Airbus A320 Family and Boeing B737 Family of aircraft. With the existing set up at Delhi Airport, the use of TaxiBot ensures ATF savings in the range of 230- 260 Litres per aircraft per taxiing event.

- **Reduced Environmental Footprint** - Fuel saving also leads to environmental benefits in terms of emission reduction, improved local air quality and reduced noise footprint. Currently, the TaxiBot is being used for taxiing out purposes. A breakup of Landing and Take Off cycle emission at Delhi Airport, based on 2019 data (pre-covid) shows, the share of taxi out emissions is highest (Figure 4).

This initiative is ensuring reduced taxi out emissions at Delhi Airport. Use of TaxiBot leads to approximate emission saving of 532 kg CO_2 per aircraft taxiing for an average TaxiBoting Time of 14 minutes. Apart from this local air quality benefits of TaxiBots are- 1.05 gm of hydrocarbon, 4.65 gm of carbon monoxide and 0.57 gm of nitric oxide emission reduction per aircraft per taxiing. These values are based on emission estimation procedures by ICAO Doc 9889 and ICAO Aircraft Engine Emissions Databank[2].

2 https://www.easa.europa.eu/domains/environment/icao-aircraft-engine-emissions-databank

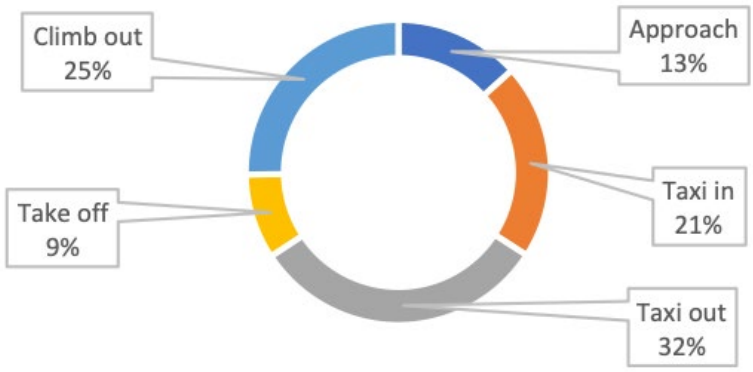

FIGURE 4: Break Up of LTO Emission at IGIA

As of March 2022, Delhi Airport has completed more than 2000 TaxiBot missions[3] and achieved ATF savings of 371 Tons, CO_2 emission reduction of 1,173 Tons. In additional to this, the 2000 TaxiBot missions have also helped in 140 hours of ground time saved, 467 hours engine life saved.

The savings in ground time further ensures improved operational efficiency by reducing turnaround time and increased throughput at airport gates benefiting both the Airport Operator and Air Traffic Control while enhancing apron safety quotient during the taxiing phase. This has also resulted in significant financial benefit to airlines to the tune of 44.27 million INR (as per todays ATF cost to Airline) in terms of fuel cost savings.

Way forward

Currently 2 TaxiBots are deployed at Delhi Airport, which can handle 30-40 aircraft/day. In addition, DIAL is planning to add 15 more TaxiBot's in a phased manner over the next 3 years, which will further multiply the carbon emission as well as local air quality benefits in the region.

Following the success of Delhi Airport, a number of Indian airports as well as few global airports are planning to adopt TaxiBot to support the business sustainability.

3 http://taxibot-india.com/services/