Collaborative Environment Management (CEM) in practice

Case studies

Operational Stakeholder Collaboration at European Airports

Edition: 1.0
Edition date: December 2021
Reference nr: 21/12/15/01

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This document is published by EUROCONTROL for information purposes with the intention to share experiences gathered about operational stakeholders collaboration at and around European airports concerning environmental projects and to give practical examples of where and how Collaborative Environment Management (CEM) arrangements can be implemented.

The document should be read in conjunction with the EUROCONTROL Specification for Collaborative Environmental Management (CEM). EUROCONTROL CEM Specification, which has been developed and maintained together with EUROCONTROL stakeholders, formalises the collaboration among the core operational stakeholders at European airports, to minimise the environmental impact of their combined operations.

The case studies included in the document demonstrate real life active collaboration in tackling the environmental challenges faced by airports and their operational stakeholders. Depending on the context, some airports have already implemented formal CEM working arrangements while others are still at the initial step of the process, but all value the importance of this collaborative approach and have engaged to develop it further.

Readers who would be interested in receiving more information on a specific Case Study are invited to send a request to the EUROCONTROL focal point at aviation.sustainability@eurocontrol.int.

These case studies have been compiled by the EUROCONTROL Aviation Sustainability Unit based on information provided by our stakeholders. It is our intention to further update and enrich these case studies as they evolve. While every effort has been made to ensure the accuracy of the information, EUROCONTROL expressly disclaims any and all warranties with respects to any content within the document, express or implied. The use of this document is at the user's sole risk and responsibility.

1- RECENT CASE STUDIES AT EUROPEAN AIRPORTS

Charleroi airport: CEM agreement to reduce environmental impact of airport operations

Context and stakeholders

On 30 November 2021, Brussels South Charleroi Airport, the SOWAER, Eurocontrol, skeyes, SABCA, Ryanair, TUI fly and Air Corsica signed a collaborative agreement designed to reduce the environmental impact of Charleroi airport operations.

The Collaborative agreement includes the creation of an Environmental Committee, which becomes an integral part of the environmental policy of the airport. This environmental policy aims at tackling three top priorities: reducing greenhouse gas emissions, as well as noise, whilst also improving air quality around the airport. Through the CEM agreement, all partners commit to collaboratively pursue these objectives.

Agreement

The main objectives of the CEM working agreement are:

- To identify the challenges as well as the short- and long-term issues for Brussels South Charleroi Airport;
- To develop a shared environmental strategy and action plans to minimise environmental impacts (noise, air quality, greenhouse gas emissions);
- To define performance indicators designed to analyse the fulfilment of the environmental objectives established between the different stakeholders;
- To promote a better understanding of the interdependence between the airport, the airlines and the air navigation service providers as a whole;
- To support and help the airport grow, while reducing its impact on the environment
- To support environmental certification processes such as ISO 14001:2015 or BSCA's involvement in the Airport Carbon Accreditation (ACA) scheme;
- To facilitate the exchange of knowledge and expertise between the different stakeholders involved in CEM.

Benefits

skeyes, as an air navigation service provider, will bring its experience in CEM and in environmental projects that have started bearing fruit in Belgium, such as improved green landings (CDO or Continuous Descent Operations) and a reduction in low-altitude holding.

Building on the collaboration with its partners, Brussels-Charleroi Airport commits to reducing its CO2 emissions by 35% compared to 2019 by 2030, and to becoming carbon neutral by 2050.

Brussels South Charleroi Airport introduces CEM - press release

Liege airport: CEM partnership to support sustainability plan

On 4 May 2021, Liege Airport, the Sowaer and skeyes signed a CEM working arrangement with FEDEX, ASL Airlines Belgium, CAL Cargo Airlines and Challenge Airlines in view of reducing efficiently and sustainably the environmental impact of aviation at and around the airport.

This agreement built on the experience acquired by the partners since the CDO implementation back in 2015-2017 (see the 'Liege airport: CDO implementation' Use Case in next chapter).

The parties meet on a quarterly basis since September 2020 to elaborate joint solutions to the environmental challenges of Liège airport. Thanks to the wide expertise covered by the partners, the group will be able to extend its scope of actions as required.

The agreement pursues the following objectives:

- developing a joint strategy and action plans to address environmental impacts (noise, local air quality, GHG emissions);
- promoting a better awareness of the aviation activities at and around the airport;
- assisting the airport in achieving sustainable development;
- supporting the airport in its ISO 14001:2015 certification and its participation to the ACA (Airport Carbon Accreditation).

Among its environmental objectives, Liege airport committed to achieve zero carbon emissions by 2050, without using carbon off-setting programmes.

More on the CEM strategy at Liège airport:
https://www.liegeairport.com/corporate/en/news/liege-airport-bolsters-its-environmental-strategy/

Swedavia: Provision of Sustainable Aviation Fuel

Swedavia is a partner of the Fly Green Fund – aiming at increasing the use of SAF

Historical context

Swedavia has been an early adopter of the CEM principles (see the 'Arlanda and Bromma airports: Green Approaches and Noise Reduction' Case Study in next chapter).

Since 2014, Sweden with Swedavia in the front has conducted a number of pioneering initiatives for SAF delivery:

- 2014: Karlstad Airport was first in the world with SAF stored at the airport and first SAF-flights in Sweden by NextJet.
- 2015: Fly Green Fund was founded as the first economic organisation to co-finance SAF.
- 2016: Swedavia was the first company in the world buying SAF for all business travel.
- 2019: Swedavia and Jämtkraft offered others to join in a joint public tender of SAF. Swedavia continued with this annually.
- 2020 (extended to 2022): Swedavia launched a SAF Incentive Programme – a support granted to airlines willing to invest in sustainable aviation fuel. Swedavia will pay 50% of neat SAF price refuelled by airlines that participate in the programme.
- 2021: reduction obligation of SAF was introduced in Sweden.

Benefits

Swedavia has acquired best practices in the development of tendering, including technical specifications and joint tendering with peer airports, which it is ready to share further with other airports in the CEM context. Swedavia has adopted a strategy for electric aircraft and is currently reviewing tour power supply and infrastructure related to electric aircraft, which will serve two big electric aviation projects currently taking place at Åre Östersund Airport and Umeå Airport.

More on the Fly Green Fund at: https://flygreenfund.se/en/

Approach for SAF deployment at Zurich Airport

Context

Zurich airport is active on all fronts of climate protection, from low energy buildings to the provision of electric systems reducing aircraft fuel consumption on the ground, consequently reducing emissions of carbon and air pollutants. Their engagement on environmental matters started as early as 1991 when they launched an inventory of their energy consumption and climate emissions. They pursue a dual strategy: to decarbonise their own activities while supporting their partners in the decarbonisation of the aircraft related emissions, which represent 90 per cent to the 'airport system' carbon emissions.

The way Zurich airport developed SAF uptake is an example of creativity combined with the systematic use of a collaborative approach with airport partners, based on the CEM principles. SAF became available in Switzerland for the first time in 2020 when Zurich Airport drove the initiative following a call from the World Economic Forum to provide it to business jets during their Annual Meeting in Davos. Using the Davos Forum as a showcase to reach business aviation on a global scale was the brilliant idea that triggered the whole story.

Stakeholders

The first step was to establish a demonstrator supply chain for SAF, which involved a cooperation with the local fix base operator, Jet Aviation, and the support from several business aviation associations. This included negotiations with the Federal Customs Administration, Federal Office for Public Health, the compulsory fuel stock piling organisation and the airport fuel farm operator. Meanwhile, Jet Aviation developed the

commercial process with a SAF manufacturer, logistics provider and potential customers.

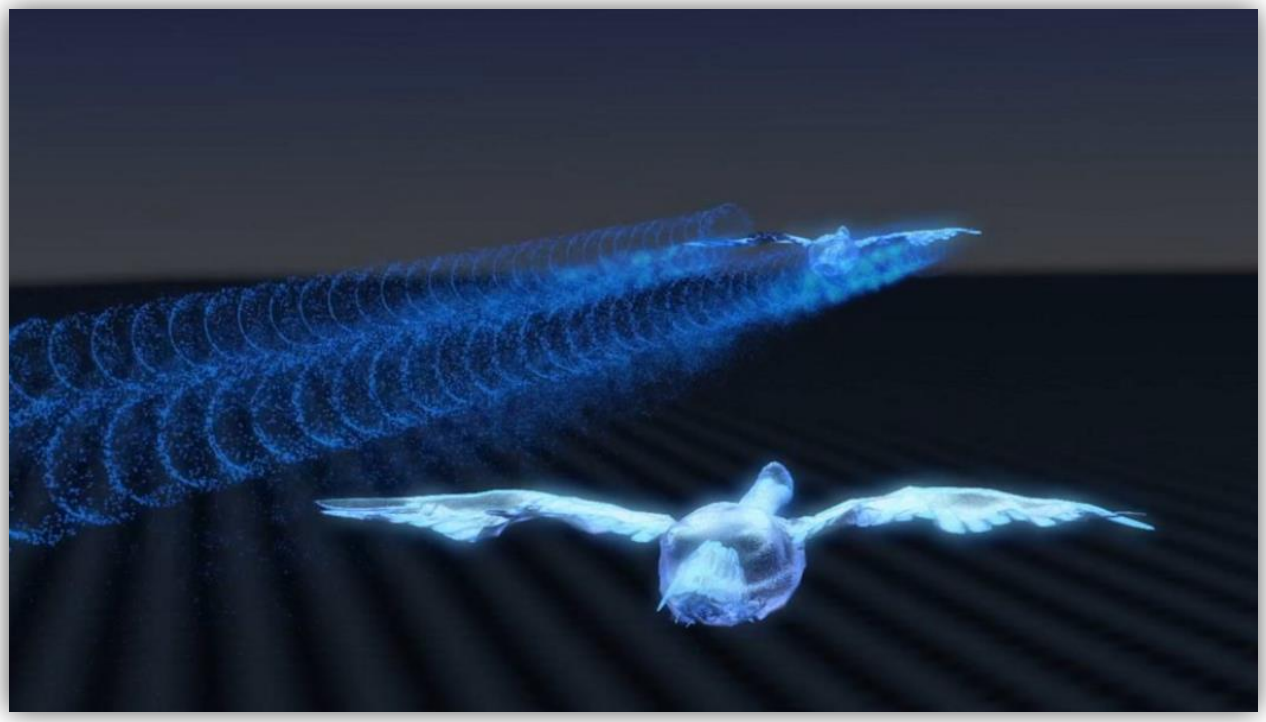
Benefits and perspectives

The initial benefit was the saving of 115 net CO2 tons resulting from the SAF ‘proof of concept’ project. Since Jet Aviation has built from this demonstrator to establish a commercial process, any aircraft operator in Switzerland, no matter at which airport or facility, now has the possibility to import SAF through a regular process. This will be of further importance when the anticipated EC ReFuel Aviation Initiative with a SAF blending mandate becomes regulation and Switzerland chooses to adopt a similar approach. It is likewise important for other future aviation fuels like synthetic kerosene from power-to-liquid of even sun-to-liquid processes.

However, as it might not always be economically feasible to transport SAF to each airport physically, fuel substitution with emission reduction can occur at any location and can be credited through book-and-claim mechanisms. Therefore, on top of actively facilitating the process of deploying SAF, Zurich Airport also supports industry initiatives such as the Council on Sustainable Aviation Fuels Accountability (CoSAFA), which aims at accelerating the industry’s movement toward further decarbonizing aviation and increasing the adoption of sustainable aviation fuels (SAF).

More information on: CoSAFA.

fello'fly: flying in formation



Airbus – fello'fly uses the flight technique of wake-energy retrieval inspired from birds

Expected benefits and stakeholders

Airbus's fello'fly concept aims at reducing emissions and fuel consumption, with estimated efficiency gains of up to 10%. Inspired by the flight of migratory birds - which fly together to save energy - two aircraft are set to meet and fly in formation. The follower aircraft will retrieve the energy lost by the wake of a leader aircraft, by flying in the smooth updraft of air it creates and thereby significantly reducing emissions on long-haul flights.

The fello'fly project is a technology demonstrator and a platform through which operational stakeholders are involved collaboratively in the testing and the development of the concept of operations, namely operational experts from airlines, ANSP, airport operators and EUROCONTROL. As such, this is an interesting example of CEM approach to support the early stages of innovative environmental developments.

Collaborative solutions

Airbus completed the drafting of a first concept of operations for oceanic airspace in 2020. These activities will continue in 2021, with further flight-testing to allow a level of maturity to perform a demonstration in Atlantic airspace together with the collaborating airlines and air navigation service providers. Assuming the viability of the project is confirmed and the regulatory environment is ready, the fello'fly technology could be available around 2025.

More information available at:
https://www.eurocontrol.int/article/airbus-fellofly-reducing-fuel-consumption-10

Engine off taxiing tested at Schiphol with TaxiBot®

Schiphol airport – TaxiBot trial

Context and stakeholders

Hybrid tractors taxiing the aircraft while main aircraft engines are off can significantly decrease emissions of taxiing operations. The TaxiBot® developed by Smart Airport Systems is one of these semi-robotic hybrid towing vehicles designed for taxiing airplanes from the boarding gate to the take-off runway without the use of jet engine power. It is the first solution using this concept that was certified and deployed operationally in Europe.

Before the trial, SAS reported high expectations on this TaxiBot concept, with potentially significantly positive impact on the environment and airline expenditure:

- Up to 85% reduction of fuel consumption during taxi,
- Up to 85% reduction of CO2 and other noxious emission during taxi,
- 60% reduction in noise pollution,
- 50% reduction of Foreign Object Debris (FOD) per take-off,
- Improved gate efficiency through the reduction of wasted time during engine start-up at the gate area.

Collaborative solutions and stakeholders

Driven by the sector's wish to reduce its emissions, Schiphol airport assessed the TaxiBot in 2020, as a solution for sustainable taxiing. The primary focus was on the effects of sustainable taxiing on safety, capacity, and efficiency at the airport and of course, the environmental benefits. The study comprised an operational pilot that was carried out at Schiphol between March and August 2020, a simulation of an airport operation based on sustainable taxiing and consultations with operational experts.

Schiphol collaborated with Air Traffic Control the Netherlands (LVNL), KLM, Transavia, Corendon Dutch Airlines and ground handling companies' dnata and KLM Ground Services. The research is part of the Dutch Smart and Sustainable action

plan and the government's plan for sustainable aviation (Akkoord Duurzame Luchtvaart).

Expected benefits

While carrying out the Taxibot trial, the project team also worked on a simulation in which all departing aircraft taxied sustainably in a busy Schiphol operation. This showed that accommodating the TaxiBot operations in such a dense and complex operational environment will require some substantial adjustments to infrastructure, processes and technology. This will involve modifying the platform and taxiways so that a unique semi-robotic aircraft towing vehicle can be decoupled from the aircraft safely and efficiently. The taxiways will also have to be adjusted.

The conclusions of the trial were then elaborated in a feasibility study, done together with all project partners and using their unique expertise. Later in 2021, the project team started developing a roadmap identifying the necessary adjustments and solutions required to establish sustainable taxiing as standard procedure at Schiphol by 2030.

The feasibility study carried out in 2020 revealed that by 2030, the amount of taxiing-related emissions (CO2, CO and NOx) at Amsterdam Airport Schiphol can be reduced by over 50% if all taxiing manoeuvres are carried out by Sustainable Taxiing.

Schiphol will also start a follow-up pilot – as part of the ALBATROSS*** European programme. This pilot will involve 2 Taxibots instead of 1 and will focus on operational impacts, with hopefully a busier airside context compared to 2020. The pilot will be launched no later than at the start of 2022. The preparations for that are underway.

For the Schiphol stakeholders involved, working collaboratively on the TaxiBot trial was a useful dry run for experimenting the Collaborative Environmental Management principles, which will be fully put into practice when executing the second operational pilot.

More information available at:
https://www.schiphol.nl/en/schiphol-group/blog/sustainable-taxiing-uses-less-fuel/
Schiphol | Sustainable taxiing: Taxibot trial
https://www.youtube.com/watch?v=rCq3ktgPc1U

**** ALBATROSS is a 2-year very large-scale SESAR demonstration project that aims at developing greener flight operations to be deployed in the short-term.*

IBERIA Zero Cabin Waste

Context and stakeholders

Iberia together with Ecoembes, Gourmet Gate (GG), Ferrovial and ESCI-UPF have developed the LIFE Zero Cabin Waste Trial Project, running from September 2016 to December 2019.

The aim of this project was to improve the management of waste derived from the catering service of flights, where two types of waste are generated:

- Category 3 waste generated on Community flights – within the European Union, and,
- Category 1 waste, generated on non-Community flights.

Collaborative solutions and benefits

Throughout the project's lifetime, the different waste streams generated in the aircraft cabin were studied. The outcomes feed into proposals for minimisation measures and to implement separation of residues (recoverable and non-recoverable fraction), as well as the collection and treatment of the different flows of waste.

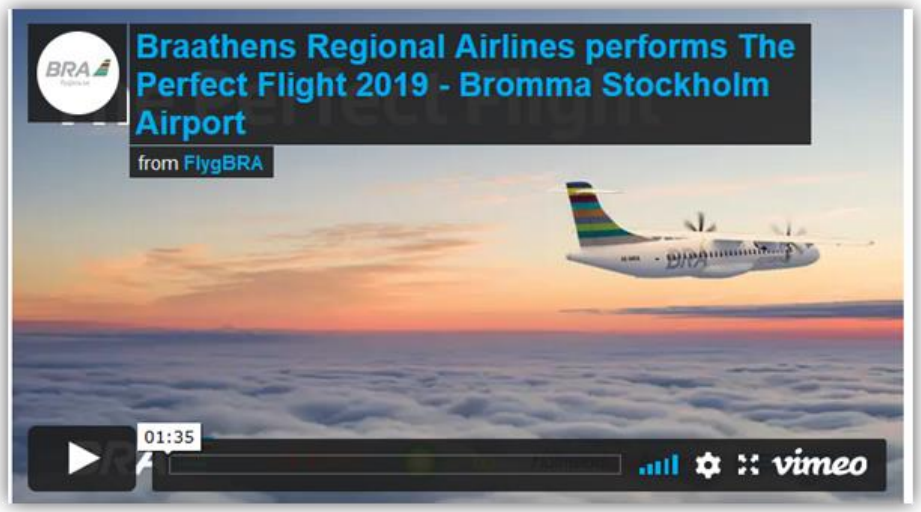
In particular, concerning Category 1 waste (Cat.1) since the European legislation only advises its destination to landfill or incineration, it was proposed to use an alternative management system that allows the application of sustainable measures to the treatment of this waste.

Close collaboration took place between the stakeholders at the airport, in line with the CEM principles. The results achieved, through, during the project development were:

- 12% reduction in waste per passenger thanks to the measures implemented;
- 42% of waste recovered, recycling 1,236 tons in 2019;
- Waste taken to landfill reduced by 2,049 tons;
- Reduction of GHG emissions by 2,264 tons of CO_2 equivalent in 2019;
- Reached more than 5.6 million passengers and more than 1,200 stakeholders through dissemination activities.

More on the Zero Cabin Waste project.

Braathens Perfect Flight



Context

As environmental consciousness rises, aviation is coming under fire. This is especially true in Sweden where terms such as 'Flygskam' – a literal translation of flight shame – are being used. Nonetheless, it is possible to fly responsibly, and Swedish airline Braathens Regional Airlines set out to prove this with the 'Perfect Flight'.

The objective was to prove that, by encouraging all air transport stakeholders to work together (manufacturers, airlines, airports, fuel industry) and by using currently available technology, it is possible to reduce CO2 emissions in the air transport sector. A challenge met with success on 16th May 2019, when Braathens Regional Airlines operated a Halmstad to Stockholm-Bromma commercial flight, with 46% fewer CO2 emissions compared with a traditional flight.

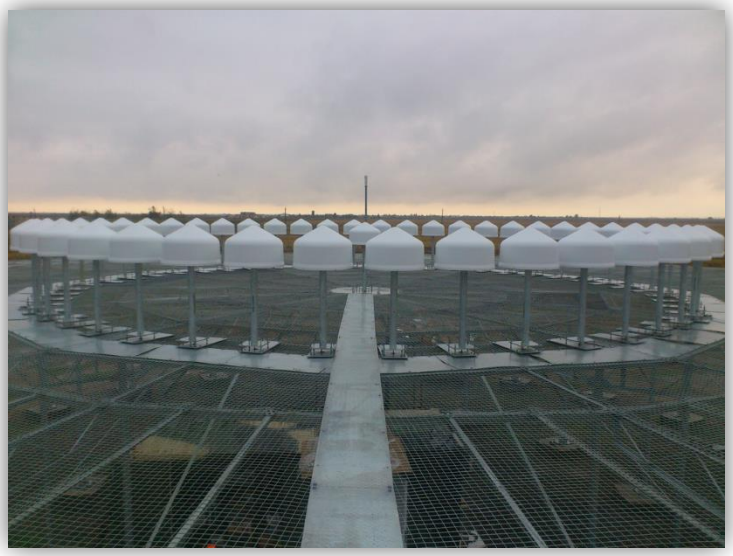
With 50 percent sustainable aviation fuel (SAF) in the tank, every element of the flight management process was optimised to keep carbon emissions to a minimum. Assisted by the Swedish air navigation service provider, this included an optimised flight altitude, a slower approach, the straightest flight path and an already very fuel-efficient aircraft, allowing Braathens to reduce the net emissions of carbon dioxide by 46 percent compared to the same flight with fossil fuel.

Stakeholders and benefits

The flight was a collaboration based on the CEM principles between Braathens, aircraft manufacturer ATR, SAF suppliers Air BP and Neste, as well as Halmstad City Airport and Bromma Stockholm Airport.
Braathens pilot, Johan Molarin, the flight captain of the Perfect Flight: "Planning this flight has been very exciting because it's not been focused on future possibilities; it's about technology we have today!"
Following the flight, a responsible aviation seminar was held at Stockholm Bromma airport. A host of experts shared their views on environmental sustainability in aviation, as well as the crew sharing the results of how the flight had been achieved.

More information in Braathens video: https://vimeo.com/396648167

Brussels airport: coordinated procedures during beacon maintenance for better environmental impact



Context

As part of the regular maintenance programme for air navigation systems, the BUB beacon at Brussels Airport had to be renewed. For practical reasons, the maintenance was performed in two phases: November and December 2018; August and September 2019.

Due to the BUB unavailability, numerous conventional departure and arrival procedures – relying on the beacon – could not be used. Therefore, flight procedures based on satellite navigation (PBN) had to be developed and published.

The CEM platform for Brussels Airport was used to prepare the maintenance works, in particular to discuss amongst flight procedure designers and aircraft operators as to how the PBN procedures should be published next to the conventional procedures. Because the regulator only allowed the use of the replacement PBN procedures during the actual BUB unavailability periods, it was important that the operators could smoothly make the transition from the conventional to PBN procedures (and vice versa).

As the works were performed in two phases, the CEM members could analyse and evaluate the outcomes of the first phase to identify improvement areas prior to the second phase. These analyses comprised following items:

- PBN Departure Procedures (RNAV SIDs)
    - 3D track analysis, to ensure that there is no substantial shift in flown tracks between the PBN and conventional procedures
    - Noise analysis, to verify that there was no substantial shift in observed noise levels compared to the conventional procedures
    - Aircraft operator feedback
- PBN Arrival Procedures (RNP approaches for runway 07L/07R)

- Especially for runway 07L, the lateral and vertical trajectory of the straight-in RNP approach is substantially different compared to the conventional offset VOR approach. Therefore a thorough 3D track analysis was performed, comparing the RNP and conventional procedures.
- Analysis on the impact of RNP procedures regarding capacity and Continuous Descent Operations (CDO)
- Aircraft operator feedback.

Stakeholders

These analyses were a joint effort by the ANSP (skeyes), the aerodrome operator (Brussels Airport Company) and aircraft operators (Brussels Airlines, DHL, TUI). Each stakeholder used the data and information available to them and performed their evaluation. During the CEM, these views and analyses were exchanged. Considering that these PBN procedures are temporary, all stakeholders could formulate points of improvement. Amongst others, this resulted in additional and dedicated briefings to operational staff.

Benefits

After the second BUB maintenance period, a follow-up evaluation was performed. Ameliorations, especially for the improvement areas identified after phase 1, could be observed. For example, during phase 2 – in general – aircraft were cleared to join the RNP more upstream; this resulted in improved predictability, at an earlier stage during the arrival, and consequently lead to higher rates of CDO. These ameliorations also highlight that the output of CEM discussions result in improvements for the environment and people living in the neighbourhood of the airport.

More on the CEM platform at Brussels airport

European CCO/CDO Action Plan: More projects where CEM can help

Implementing CCO/CDO is a complex task that requires the buy in from many operational stakeholders, an ideal opportunity for making the most out of the CEM approach.

Context and stakeholders

Continuous Climb and Descent Operations (CCOs and CDOs) are aircraft operating techniques enabled by airspace design, instrument procedure design and facilitated by air traffic control (ATC). CCO and CDO allow aircraft to follow a flexible, optimum flight path that delivers major environmental and economic benefits - reduced fuel burn, gaseous emissions, noise and fuel costs - without any adverse effect on safety.

CCO and CDO operations allow arriving or departing aircraft to descend or climb continuously, to the greatest extent possible. Aircraft applying CCO employ optimum climb engine thrust and climb speeds until reaching their cruising levels. With CDO, aircraft employ minimum engine thrust, ideally from top of descent and in a low drag configuration, prior to the final approach fix. Employment of these techniques reduces intermediate level-offs and results in time being spent at more fuel-efficient higher cruising levels, hence significantly reducing fuel burn and lowering emissions and fuel costs (see ICAO Doc 9993 and ICAO Doc 9931).

Benefits

Deployment of optimised CCO and CDO throughout Europe will be beneficial to all European ATM system stakeholders and will help the network to address the environmental challenges it faces. CCO/CDO are typically complex multi-stakeholder environmental projects which implementation can be facilitated by applying the CEM principles and formal process.

In 2018, EUROCONTROL conducted an ECAC-wide CCO and CDO analysis using 2017 traffic data, in order to estimate the potential network benefits of optimising the CCO and CDO in terms of fuel savings, emissions reduction and fuel costs.

The ECAC-wide study identified two main conclusions:

- The results indicate that in Europe the potential savings from optimising CCO and CDO are up to 340,000 tonnes fuel/year, (1.1M tonnes CO_2/150M EUR) *;
- The potential fuel saving benefits from CDO are in the region of x10 those from CCO.

(*) It should be noted that the achievement of 100% CCO and CDO across the European network may not be possible for a number of reasons, such as safety (i.e. the need to keep aircraft separated by a certain distance or time), weather, capacity or ATCO workload, all of which may be considered as interdependencies, while small inefficiencies in the system are required to operate a flexible and operationally efficient network.

For more information on CCO/CDO Case Studies please consult the latest European CCO/CDO Action Plan 2020 Annex Q: https://www.eurocontrol.int/publication/european-cco-cdo-action-plan

2- COUNCILS/ASSOCIATIONS ENCOURAGING THEIR MEMBERS TO USE CEM

Airport Councils and Airline Associations also want to play their part in promoting the use of CEM.

Airport Regions Council (ARC) calls for CEM implementation

Airport Regions Council is the association of regional and local authorities with an airport situated within or near their territories. A common concern expressed by ARC's members is to maximise the benefits generated by airports and to minimise their environmental impact.

Ready to be more sustainable? Time to launch CEM! - YouTube

No single operational stakeholder can minimise environmental impacts alone, so it is important that airports, regions and airlines make the best possible use of Collaborative Environmental Management.

ARC has become convinced that "CEM contains a sound generic methodology that facilitates concrete collaborative solutions,… can help manage the relationship with the airports, … and may help solve issues that many European airport regions are facing now and in the longer term". It promotes CEM actively towards its members. In February 2021, ARC organised a webinar together with EUROCONTROL, European Regions Airline Association (ERA) and Wallonia Region's Airports (SOWAER) to get insight from real cases.

Building from their peers' experience, "ARC members believe that the CEM working arrangement must always include permanent dialogue and agreements with local authorities and communities as *a must*".

More information on ARC's call for CEM

IBAC/EBAA & GAMA encourage business aviation to use a CEM approach

The Business Aviation Commitment on Climate Change (BACCC) was reinforced in October 2021

Context

The publication of the Business Aviation Commitment on Climate Change (BACCC) in 2009 highlighted the seriousness with which Business Aviation takes its environmental responsibilities. The BACCC is a joint initiative of the International Business Aviation Council (IBAC) - represented in Europe by the European Business Aviation Association (EBAA) - and the General Aviation Manufacturers Association (GAMA). Its goals are:

- to achieve carbon neutral growth by 2020;
- to reduce total CO_2 emissions of 50% by 2050 relative to 2005; and
- an improvement in fuel efficiency of an average of 2% per year from 2009 until 2020.

These objectives will be achieved through four key pillars; technology, infrastructure and operational improvements, alternative fuels, and market-based measures. The BACCC was updated in 2015 and in October 2021, the partners announced their commitment to push further their sustainability ambitions by setting a higher goal of net-zero carbon emissions by 2050.

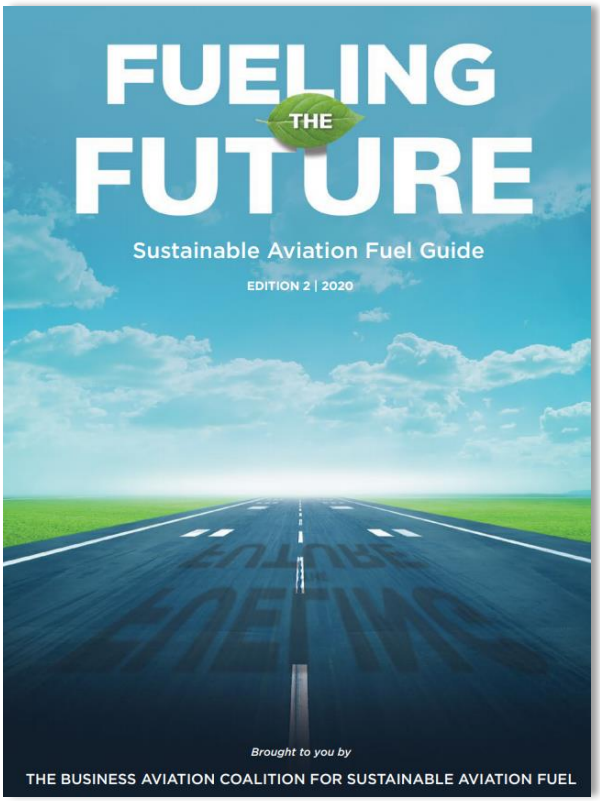
Collaborative solutions and benefits

Business Aviation considers the EUROCONTROL Collaborative Environmental Management (CEM) approach, through providing a facilitative platform for discussion, whereby all relevant stakeholders can support the search for solutions that ensure the maximum potential for operations, as particularly helpful in achieving its goals within the BACCC in two of its four pillars: operations and infrastructure.

The business community thus recognises the value of CEM in achieving its goals and as another valuable mechanism that will contribute to reducing the sector's overall environmental impact.

More on the BACCC and the business aviation pledge for net-zero emissions by 2050

The SAF coalition's guide: a complementary tool to CEM to support SAF uptake



Collaborative solution and stakeholders

The SAF Coalition – which includes the Commercial Aviation Alternative Fuels Initiative (CAAFI), the European Business Aviation Association (EBAA), the General Aviation Manufacturers Association (GAMA), the International Business Aviation Council (IBAC), the National Air Transportation Association (NATA) and the National Business Aviation Association (NBAA) – developed a guide, titled, *Fueling the Future*, to support SAF uptake. This guide serves as an educational and informational resource about the practicalities of SAF development, industry adoption, and pending expansion of supply and use, primarily from the perspectives of the business aviation community.

The SAF Coalition's guide builds upon a host of initiatives to educate industry leaders, policymakers and others on the benefits and viability of SAF.
For example, in January 2020, the coalition introduced SAF for business aviation consumption at Zurich Airport, in conjunction with the World Economic Forum. Similar, previous events were held at airports in Van Nuys, CA, Farnborough, UK, Geneva and Las Vegas.

Source: https://www.ebaa.org/press/press-release-coalition-releases-new-sustainable-aviation-fuel-guide-as-industry-moves-to-accelerate-use-of-lower-carbon-alternative/

Link to the SAF Coalition Guide: **futureofsustainablefuel.com**

3- CASE STUDIES FEATURING "CEM PIONNEERS"

Although these projects took place in the early times of CEM development and may be terminated today, it is interesting to keep track of their achievements, as they remain a valid source of inspiration for new CEM practitioners.

Vienna: Relations with External Partners

Context and stakeholders

Vienna Airport has had a Mediation Forum since 2000. At that time, there was no CEM as such yet, but Vienna Airport was a precursor of the concept by setting formal arrangements with a wide range of stakeholders, including surrounding communities. The Mediation Forum was one of the outcomes of the Master Plan 2015 published in 1998 calling for the development of Vienna Airport to meet increasing future traffic needs. One of the needs identified was the addition of a third runway.

In the Forum, the following parties take part in discussions about possible improvements to the environmental situation and the future development of the airport and its surroundings:

- ATC
- Austrian Airlines
- Vienna Airport
- Mayors of the surrounding communities
- Politicians from different parties
- Association of NGOs

In addition to this, ATC Operations meetings are held on a regular basis with ATC, Airlines, Airport and the Ministry of Transport where mainly practical operational questions are discussed. These meetings can also be used to negotiate environmental matters. Other meetings are held with airlines as customers of the airport.

Collaborative solutions and benefits

Vienna Airport founded its Dialog Forum in 2005 as an outcome of the Mediation Forum created in 2000. Within this Forum, there is the opportunity to discuss issues of concern with neighbouring communities, political parties and NGOs together with ATC and

Airlines. Other issues such as possible improvements of the environmental situation and the future development of the airport are also raised. For example, the construction of the third runway and its aftermath was on the agenda.

Benefits from the Dialog Forum can be seen in the acceptance of the airport and its future development plans by the surrounding communities and local authorities. Each complaint from residents is now brought forward to the relevant working group in such a way that the complainant gets an answer to his/her concerns. Mitigation is possible, as the relevant stakeholders are at the table and decide on measures which can be taken to improve the situation.

In Austria, land use planning authorities are not obliged to take aircraft noise zones into account. However, Vienna Airport has been proactive in making contacts with this authority, thus avoiding development of populated areas in the surroundings of the airport. In addition, there is now a contract with the surrounding authorities that they do not create new housing areas within certain noise contours.

Manchester: Operational Improvements facilitated by Collaborative Environmental Management

Manchester is the UK's third largest airport. In 2017, it handled 27.6 million passengers travelling on nearly 204,000 flights, handling around 19 million passengers, and with around 19,000 people employed on site. Manchester is the only UK airport to have both two full-length runways and significant spare capacity, with the ability to match the demand for aviation growth in the UK. For its size, Manchester is unique in that it has no single dominant airline customer – instead, sixty airlines operate to 200 destinations – meaning the airport hosts an incredibly diverse range of aircraft types, from small regional aircraft to wide bodies.

Manchester Airport has a long history of collaborative approaches to environmental management and stakeholder engagement, predating even the development of their second runway, which opened in 2001. Manchester was therefore a natural partner to EUROCONTROL in developing the initial Specification for Collaborative Environmental Management (CEM), and the first UK airport to implement a CEM working arrangement.

Collaborative solutions and benefits

The airport implemented CEM through the creation of its CEM Group in 2010. The Group meets four times a year and includes representatives from airlines, air traffic control providers, the airport company and other organisations relevant to the meeting agenda – for example handling agents. The CEM Group works successfully alongside a range of pre-existing platforms, with which it exchanges information, views and opinions, including the:

- Airport Consultative Committee, and Technical Advisory Group
- Flight Operations Safety Committee
- Airline Operators Committee
- Environmental Health Officer's Working Group

CEM has, alongside Manchester's other collaboration platforms, supported the development and implementation of mitigation programmes included in the airport's Sustainable Development Plan, Noise Action Plan and Night Noise Policy. Examples include:

- Improvements to aircraft track keeping by departing aircraft and the implementation of continuous descent approaches for arriving aircraft, reducing noise impacts and emissions;
- The development of procedures and type approvals for reduced engine taxiing, including live runway crossings, reducing taxi emissions by up to 40%;
- Enabling and promoting the use of zero-carbon renewable electricity to cut noise and emissions from parked aircraft through us use of 'FEGP'.

The CEM working arrangement at Manchester provides value to both the airport and its customer airlines. In doing this, and supported by other engagement forums, the airport has a thorough understanding of the context of its organisation and the needs and expectations of its stakeholders thus underpinning the airport's Environmental Management System and fulfilling the requirements of ISO14001.

CEM also supports continual improvement, another key requirement of Environmental Management Systems, both in terms of improved performance and the introduction of innovative solutions. To illustrate, topics covered within CEM have been as diverse as to support the introduction of the UK's first LED runway and high-mast apron lighting, confirming the safety benefits of new types of lighting which reduced energy use by over 70%.

Arlanda and Bromma airports: Green Approaches and Noise Reduction

Stockholm Arlanda airport (Swedavia image)

Stockholm Arlanda: curved approaches and reduced charges for quieter aircraft

Sweden has a long track-record of environmental initiatives based on the CEM principles. Sweden's largest airport Stockholm Arlanda has been working in partnership with its core operational stakeholders to look at various ways to reduce aircraft noise; and with local communities to ensure that the least amount of people are disturbed by it. Swedavia (the airport), airlines and LFV (ANSP) cooperated in the 'Green Flights' project initiated in 2007.

Additionally, Stockholm Arlanda also worked using the "Stenvändarprocessen" (Swedish for "the stone turning process") – an extensive project in which the airport was "turning every stone" to find new ways of reducing noise disturbances from air traffic. Although this project is now closed, many measures that were identified are now in use. One example is the yearly updating of the Airports Noise Management Plan.

Lower take-off charges for aircraft with cleaner and quieter engines and the use of green approaches are examples of some of the measures Swedavia and its partners are working with in order to reduce the environmental impact of air traffic. Sweden was one of the first countries in the world to introduce this type of charging. The purpose is to persuade airlines with older planes or old aircraft engines to replace them with more environmentally friendly alternatives. The introduction of green approaches reduces noise, fuel consumption and thus atmospheric emissions.

At the end of March 2010, SAS became the first airline to be granted formal permission by the Swedish Transport Agency to use "curved approaches" (RNP AR) with the SAS Boeing 737NG at Stockholm Arlanda's third runway, 01R. Since early 2006, more than 40,000 Green Approaches have been made and the results show that each approach can save up to 100-150 kg of fuel. Since then, a number of additional and improved curved RNP AR approaches have been introduced which has increased the usage

from only a few per year to around 1 000 RNP AR approaches per year, saving fuel and avoiding noise sensitive areas during the final approach.

Open dialogue and heightened environmental awareness

In addition to measures aimed at limiting noise, the airport also carries out measurements and test flights as well as programmes aimed at helping air traffic controllers and pilots further increase their environmental awareness. An open dialogue with Stockholm Arlanda's neighbours is another important element of the process. The airport endeavours to locate its flight paths where the noise will cause the least disturbance to the fewest people possible. The homes most heavily exposed to noise are noise-proofed.

Cooperation with noise abatement associations

Stockholm Arlanda Airport applies the CEM principles when meeting representatives of the noise abatement associations in nearby communities such as Upplands Väsby, Sollentuna and Rosersberg several times per year. Outcomes of these meetings have resulted in a number of suggestions for noise-reduction measures, some of which have been implemented or are in the process of being implemented.

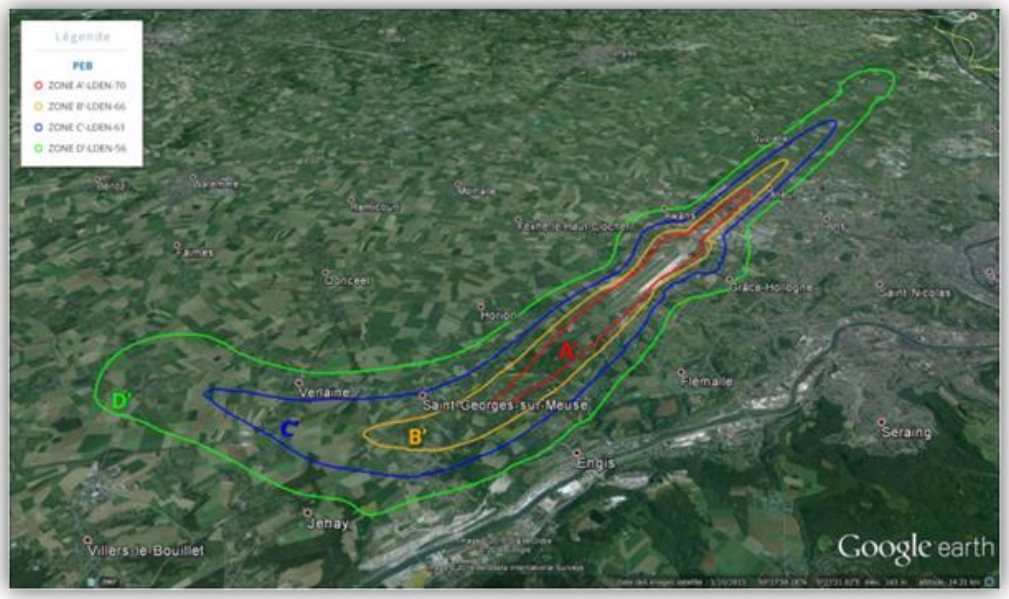
Stockholm Bromma – Noise reduction initiatives

Stockholm Bromma Airport also applies the CEM principles when working together with the City of Stockholm, County Administration, and the Swedish Transport Administration to define areas where houses can be built with regard to the airport's future noise curves and height restrictions. This work contributes to a better understanding of the needs of the airport and the City of Stockholm. It is expected that the resulting reports which will include information on height restrictions of buildings and the influence of noise will be used by all parties over the coming years to secure both the functioning of the airport and the City of Stockholm's requirements to build new housing.

The City of Stockholm and the airport are also working together on a specific project, close to the airport; the objective in the first instance is to lower ground noise levels by looking at the planning of non-residential buildings as shields against noise. The effect that the buildings will have on shielding against take-off noise will also be evaluated.

Stockholm Bromma Airport is a city airport with a high focus on noise issues. The airport has an approach angle of 3.5 degrees. To evaluate which effect a steeper angle could have on the noise levels, a project was introduced including the main airline operators and the ANSP (LFV) at the airport. One part of the project included test flights with an angle of 4.25 degrees. The results were evaluated. However, due to some airlines indicating problems with a steeper approach, it was not possible to introduce this at the airport. Nevertheless, the project entailed a close and valuable collaboration that involved discussions on other noise reduction activities.

Liège Airport: CDO Implementation



Liege's map of noise zones, a central factor to the CDO project

Context and stakeholders

Continuous Descent Operations (CDO) based on vectoring were implemented at Liège Airport on the 7th December of 2017 after almost two years of intensive collaboration between the main stakeholders that were involved in - and or - impacted by - potential operations.

The need to put in place a working group based on a CEM model was identified during the CDO kick-off meeting in November 2015 due to the number of stakeholders that are required to coordinate and collaborate in such complex airspace. The TMA (Terminal Manoeuvring Area) is surrounded by military and low-flying areas. Operations are close to Liège City, there are substantial night cargo operations and the Dutch frontier is located nearby, making this project even more sensitive.

The working group based on the CEM model included:

- Representatives from Liège Airport, from both the operations and environment domains;
- Belgocontrol (Belgian ANSP), including Air Traffic Controllers;
- Airlines flying to/from Liège airport (TNT/FEDEX, TUIFly, etc.);
- SOWAER Environment (responsible for the sustainable growth of both Liège and Charleroi airports);
- Walloon Public Service (regional authority competent for noise); and
- ACNAW (authority controlling noise traffic due to operations at Walloon airports), as observers only.

Collaborative solutions and benefits

The aim of this collaboration was to identify potential operational benefits of CDO implementation at Liège airport and to assess the feasibility of CDO operations together

with any environmental risks associated to the project and the identification of any appropriate mitigations. Moreover, it aimed to:

- define and validate the CDO implementation plan;
- organise, plan and monitor the CDO implementation trials;
- organise and share training best practices for both ATCOs and pilots;
- discuss and decide any applicable phraseology; and
- approve each key milestone of the CDO implementation process.

Thanks to this collaborative working group and its quarterly meetings, the CDO implementation at has been a success. The discussions held within this group have ensured that the needs and concerns of all involved parties were taken into account throughout the life cycle of the project. For instance, noise aspects were thoroughly discussed during the meetings whilst the outcomes of analysis based on modelling or measurements were also shared within the group.

Stansted Airport: Collaborative Implementation of Performance Based Navigation (PBN)

London Stansted airport facilities (Image: Stansted airport)

Early engagement with local communities and keeping them informed played a key part in the successful implementation and delivery of PBN at Stansted Airport, as well as strong collaborative support from Airlines, NATS (ANSP), the CAA and its Consultative Committee, in line with the CEM principles.

Context and stakeholders

The London Airspace Management Plan (LAMP) seeks to modernise UK airspace structure, through a redesign of UK airspace into a Performance Based Navigation (PBN) environment. The benefits of this approach allows for increased airspace capacity, safety and performance whilst reducing the overall environmental impacts of Aviation. This can be achieved through utilising the navigational capabilities on-board modern aircraft (allowing reduced separation and increasing throughput), direct routing, and time-based separation to name but a few.

LAMP 1A, which affected airspace arrangements in south-east England, from Stansted to the Isle of Wight, was the first among the five LAMP airspace change proposals to be implemented in 2016.

Collaborative Solutions

This project was originally developed following community concerns from residents living directly beneath the runway 22 Clacton departure route in Hatfield Heath and in response to growing community annoyance that was making regional news channels. The request of the local residents was “We will be happy if aircraft follow the centre line of the SID as closely as possible” and this would then avoid the direct overflight of this community.

The CAA was approached by a member of Stansted Airport’s Consultative Committee, to request their support in “resolving” the problem. The RNP1 trial developed from this initial meeting in 2012 where the CAA suggested designing an RNP1 SID. RNP1 concentrates the aircraft much nearer the designed route, reducing the numbers of people overflown, by utilising the latest navigational capabilities of modern

aircraft which auto corrects the aircraft back onto the desired track irrespective of aircraft type or wind speed and direction.

The trial started with a single operator to test the design and was gradually expanded to other operators who had RNP1 equipped fleets. In parallel, the Stansted Consultative Committee and local communities were kept informed. The two RNP1 SID's trialled since May 2013 were welcomed by the local communities, the airport consultative committee and local, parish and district councils as they significantly reduced the numbers of people overflown and exposed to aircraft noise.

As part of the collaborative process, summer 2015 saw Stansted Airport conduct a twelve-week public consultation to implement these two RNP1 departure routes. Subsequently a formal request was submitted for a formal airspace change proposal to make the RNP1 SIDs a permanent option in 2016; this was fully published in August 2017. The percentage of RNP1 utilisation is now over 90% and continues to grow.

This technology has proved very successful at London Stansted, the trial data so far and the consultation material can be found at:
http://www.stanstedairport.com/community/local-environmental-impacts/performance-based-navigation/

Benefits

Stansted Airport has planned to implement this technology on the other four out of six departure routes. This will ensure that they are well ahead of EU obligations relating to the Single European Sky initiative - Pilot Common Project.

The RNP1 SID design allows Stansted to 'thread the needle' when thinking about future development of this technology, providing the ability to avoid the overflight of the larger communities surrounding the airport whilst enabling the further reduction of noise impact.

Applying CEM principles, such as early engagement with local communities and keeping them informed played a key part of delivery as well as well as strong collaborative support from Airlines, NATS, CAA and Stansted's Consultative Committee.

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