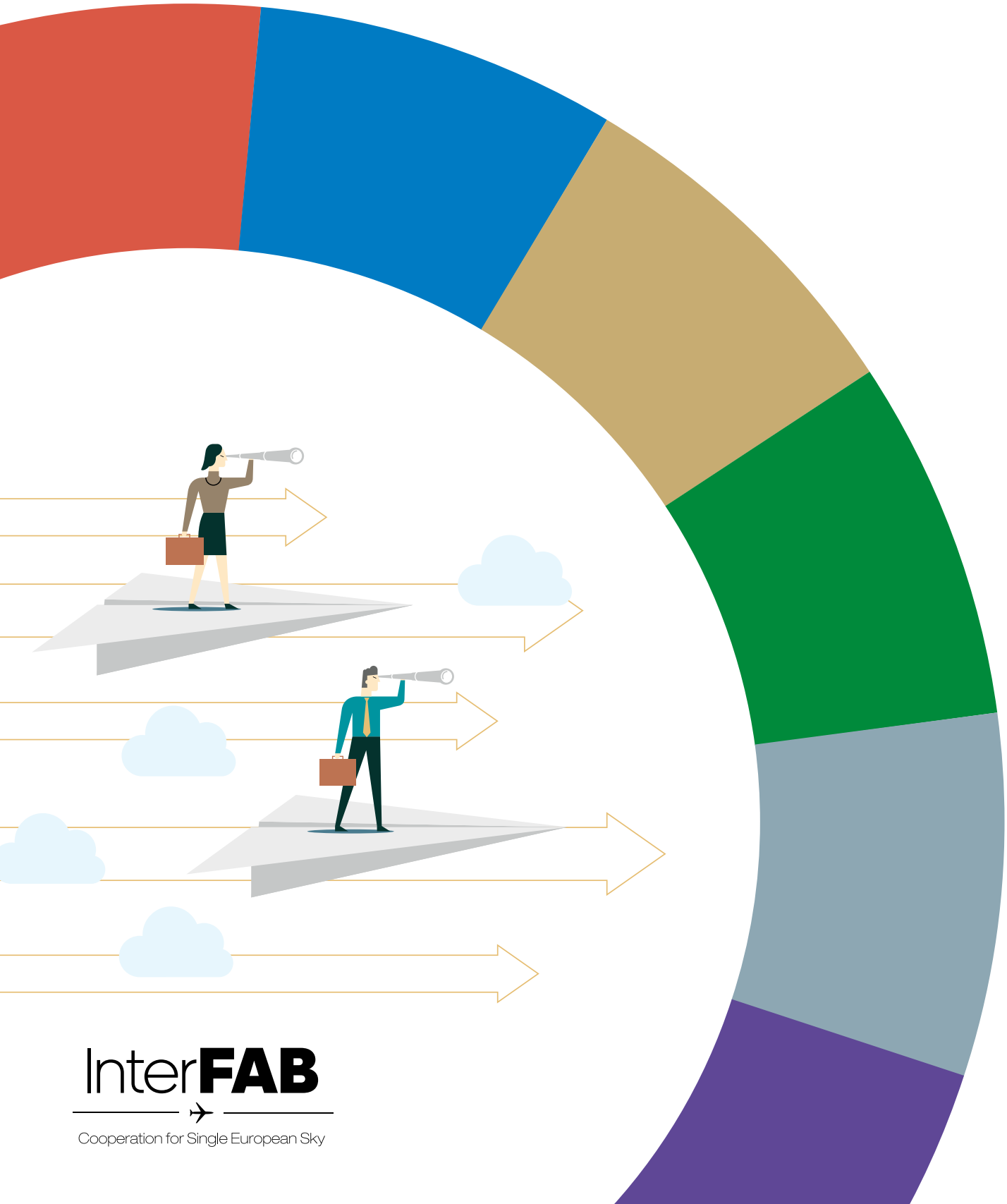
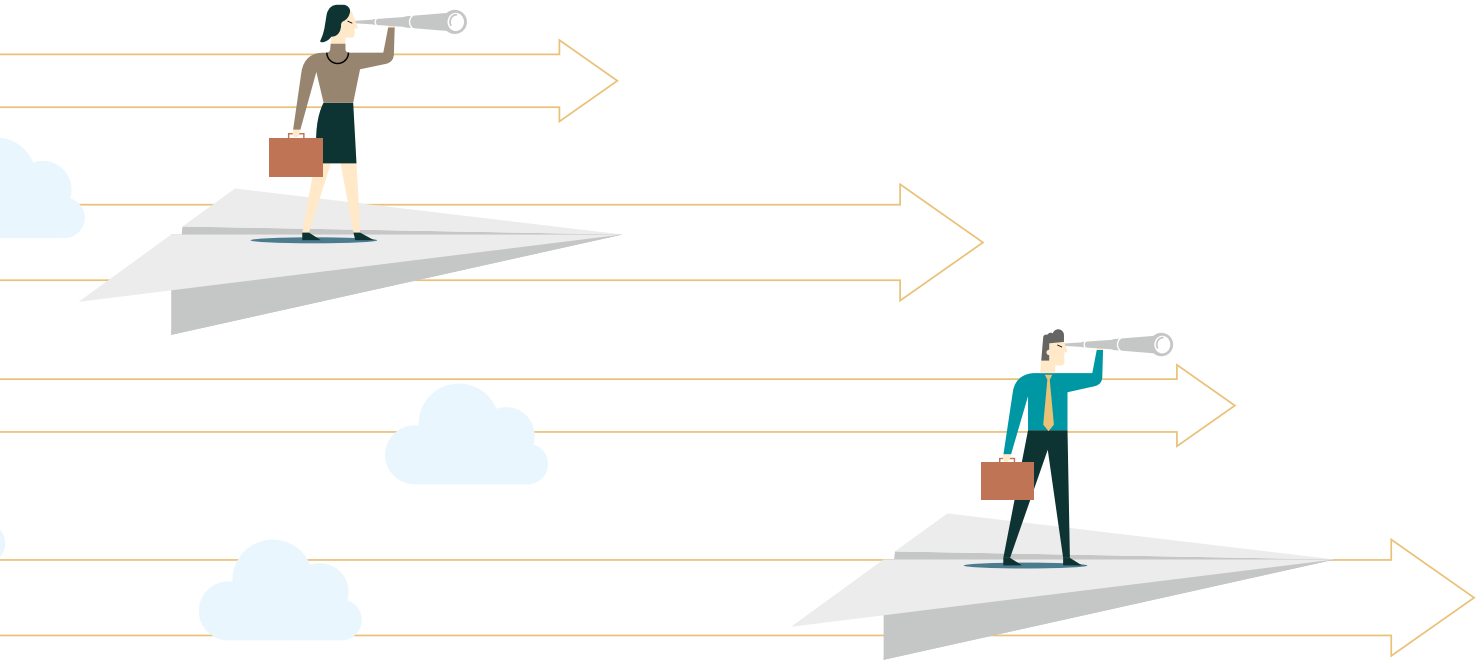
# Expert **TALKS**

2021



InterFAB

Cooperation for Single European Sky



# Our Expert**TALKS**

Air transport is in the midst of a period of significant change. The impact of the pandemic has been extraordinarily damaging with losses amounting to billions of euros across the entire aviation sector. Simultaneously, the industry is responding to the European Commission's commitment to reduce net greenhouse gas emissions by at least 55% by 2030[1] and to become the first climate-neutral continent by 2050 as part of the European Green Deal[2] initiative.

In order to meet these challenges, we need to substantially re-think our established procedures and ways of operating. We need to re-evaluate our current practices and examine innovative methods to improve how we deliver the performance expected. Achieving substantial change will only be possible through a thorough appraisal of the existing system and an open-minded approach to the solutions and opportunities that are available and under development today.

FABEC is committed to this process and with this in mind joined other members of InterFAB to host a series of six Expert Talks between March and September 2021 aimed at analysing key issues which relate to data and performance in air traffic management. Summary findings from each of these expert talks are collected together in this brochure and full research data from each event can be found on the InterFAB website.

FABEC recognises the importance of a cooperative approach to these issues and the InterFAB platform plays an essential role in reaching all actors in the aviation chain. The talks consider multiple different needs and circumstances from all over Europe, taking advantage of regional capabilities as well as network-wide opportunities, to capture a wide range of issues.

By working together in this way, the stakeholders can share the know-how and ideas that will enable us to minimise aviation's environmental footprint and ensure the airspace performs in the most efficient way for its users and the passengers as traffic embarks on recovery following the pandemic.

**Marcel G. Zuckschwerdt**
*Chairman FABEC Council*

FABEC

[1] *European Climate Law https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541*
[2] *European Green Deal https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en*

Expert **TALKS**

# InterFAB Expert Talks 2021: Focus on ATM performance improvement

This brochure provides a high-level summary of the Expert Talks hosted by InterFAB over the course of 2021. These informed discussions set out to improve the understanding of air traffic management performance data and led to an open exchange of views on key issues relating to data and performance in air traffic management.

Six InterFAB Expert Talks took place between March and September 2021, hosted by air navigation service providers (ANSPs) in Germany, Bulgaria, Italy, Lithuania, Austria and Spain. Topics included an in-depth analysis of traffic forecasts; an explanation of 'economic surplus'; new methodology to measure the cost of delay; climate change and the role of ATM; rising volatility in air traffic; and the impact of inaccurate forecasts on delays and costs. Executive summaries from each event are featured in the following pages, along with speakers' details and the main conclusions.

The results highlight the importance of interpretating performance data correctly when planning future investment and service delivery. This has become increasingly important in the face of new challenges such as recovering from the pandemic, new airspace users, rising volatility and the effects of climate change. An informed assessment of factors influencing ATM performance results is essential to building a resilient and cost-effective ATM infrastructure that can withstand sudden setbacks like COVID-19 or an ash cloud while meeting customer expectations for reduced environmental impact.

The European Commission's Green Deal requires no net emissions of greenhouse gases by 2050 and expects a 55% reduction by 2030[1]. Meeting these targets calls for cooperation between all aviation partners and a commitment to work together on solutions to deliver sustainable, efficient services for airspace users. The InterFAB platform provides an open forum for this industry discussion and sets a path for ANSPs to work collectively towards performance improvement across the region. By expanding the industry's understanding and knowledge of air traffic management performance data, the InterFAB Expert Talks represent an important step along this road.

[1] *Policy package Fit for 55 https://www.consilium.europa.eu/en/policies/eu-plan-for-a-green-transition/*

FABEC

**Alex Bristol**

*Chairman FABEC ANSP Strategic Board*

FABEC members manage Europe's busiest airspace, ensuring safe and efficient flight paths to and from five of the region's largest airports. It is not surprising to learn that small changes in airline routes, weather and airport disruptions can have a large impact on airspace capacity. The InterFAB Expert Talks provide valuable information about the relationships and interdependencies that exist between different ATM performance measures. This research is now informing FABEC policy initiatives that aim to secure consistently high performance results based on more resilient airspace infrastructure.

www.fabec.eu

BLUE MED Mediterranean FAB

**Maurizio Paggetti**

*Chief Operating Officer ENAV and BLUE MED ANSP Committee Chairman*

BLUE MED brings together four Mediterranean States' intent to support continuous improvement in airspace safety, capacity, efficiency and harmonisation through a series of cross-border projects, including free route airspace, capacity flow management and IP-based communications networks. The InterFAB Expert Talks illustrated the importance of basing policy and planning decisions on a full and comprehensive understanding of ATM data, and provided the ideal forum to share and expand on the findings and come up with strategic solutions that will benefit aviation stakeholders users throughout Europe.

www.bluemed.aero

Baltic FAB
A PART OF SINGLE EUROPEAN SKY

**Saulius Batavicius**

*CEO Oro Navigacija*

The InterFAB Expert Talks provided valuable insight into the ATM performance figures that ANSPs use to make major investment decisions. As a result of learning more about what lies behind the data and building on this analysis, Baltic FAB is working closely with neighbouring ANSPs to optimise performance and deliver long-term benefits to airspace users.

www.balticfab.eu

danubefab
functional airspace block

**Adrian Cojoc**

*Director General ROMATSA*

Industry experts have carried out in-depth research into the data used to monitor air navigation services. The results shared in the series of InterFAB Expert Talks introduce new and informative ideas about ways to maximise the performance of air traffic control. In particular, they show the consequences of relying on high-level ATM performance data when a more thorough review of the data can reveal a different outcome.

www.danubefab.eu

FABCE
AIRSPACE ALLIANCE

**Kornel Szepessy**

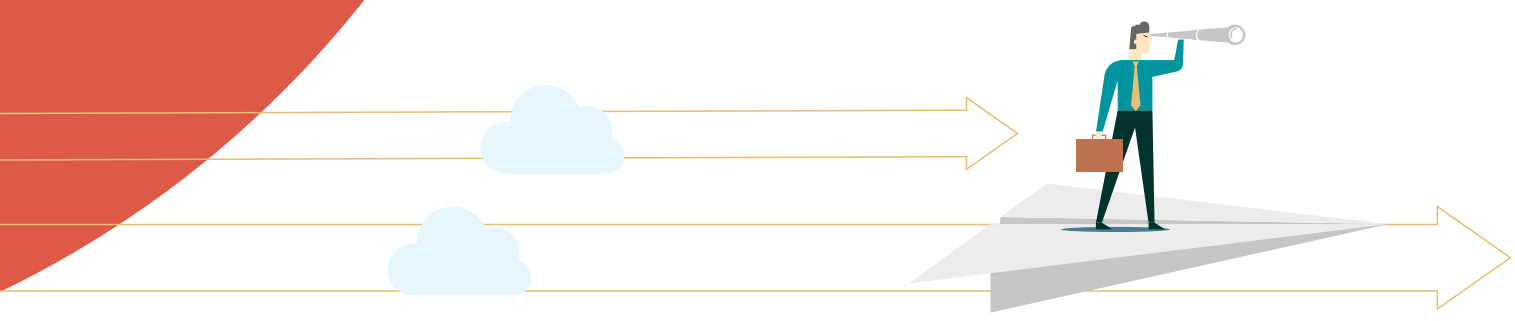
*Chair FAB CE CEO Committee*

The FAB CE Airspace Alliance represents seven separate States. It has a strong track record of collaboration in many areas, including common procurement and investment planning, where the joint venture company FAB CE Aviation Services acts on behalf of all members. The InterFAB Expert Talks add to our understanding of the complexities that accompany performance measurement and provide valuable guidance to our work of optimizing airspace management and making more effective use of resources.

www.fab-ce.eu

# TALK 1

## The accuracy of air traffic forecasts, causes and consequences



The first InterFAB Expert Talk hosted by FABEC on 2 March 2021 attended by more than 220 delegates from all over Europe discussed the impact of traffic forecasts on resource allocation by air navigation service providers (ANSPs). Prof Dr-Ing Hartmut Fricke, Technische Universität Dresden (TUD) and his team examined how the same forecast scenario applied across all European states can lead to significant variations amongst individual states between actual and predicted demand. While overall traffic levels fall within the range forecast by EUROCONTROL STATFOR, some regions experience much higher uncertainty than others, leading in some cases to hundreds of thousands of additional flights while others can incur excessive costs arising from unused resources. In view of these uncertainties, Prof Dr-Ing Fricke identified additional parameters that could be incorporated in the forecast to help fine-tune the outcome and contribute to improved performance by air navigation service providers (ANSPs).

ANSPs rely on air traffic forecasts to plan infrastructure and personnel resources to provide safe air traffic control services in a cost-effective way. The prediction horizon to secure critical controller skills is five years, covered under STATFOR's

## Our **EXPERT**

**Prof Dr-Ing Hartmut Fricke**

Director of the Institute of Logistics and Aviation at the Faculty of Traffic Science, Technische Universität Dresden (TUD)

TECHNISCHE UNIVERSITÄT DRESDEN

”

*The research identified large spreads between the different STATFOR scenarios leading to hundreds of thousands uncertain flights for some regions.*

medium term 7-year forecast horizon. The forecast provides high-, base-, and low-level scenarios that currently aim at finding at least 50% of all forecasts within this range accuracy, referred to as the Confidence Interval (CI), to provide an indication of future traffic. However, the effective CI based on real observations along the last decade did change significantly over a five-year period, for example in response to economic crises (e.g., 2009), fuel price hikes (e.g., 2012) and geopolitical events, with significant consequences for ANSPs and their ability to comply with Single European Sky performance regulations.

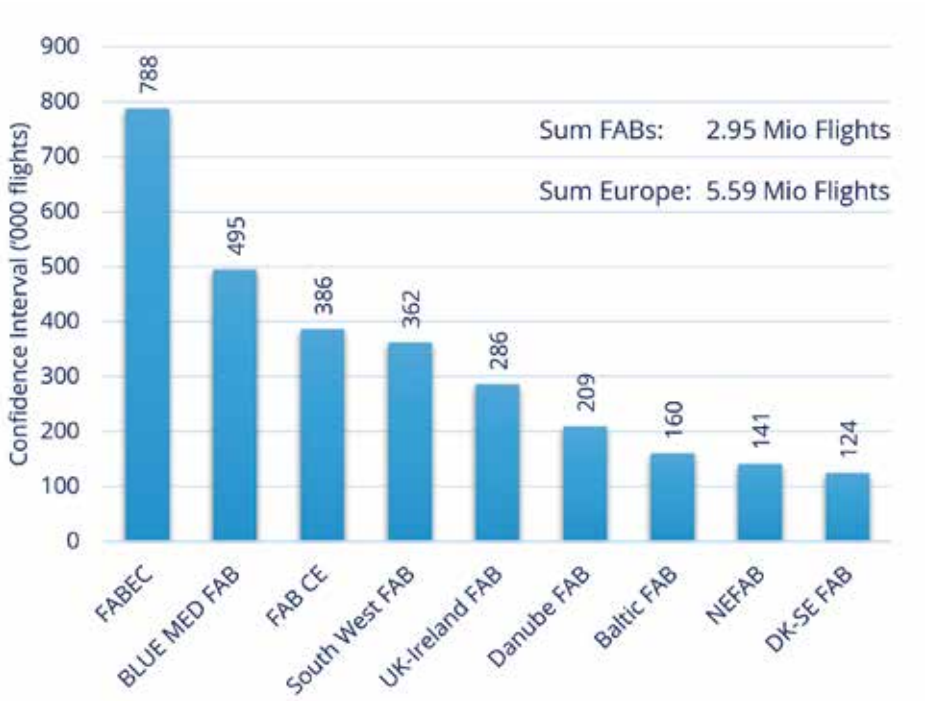
When TUD examined the impact at FAB level over a five-year period from 2019 and 2023, the research identified based on these CI fluctuations 788,000 optional (uncertain) flights across FABEC states, 495,000 in BLUE MED FAB and 386,000 in FAB CE, double the number in other FABs,

## *Traffic forecasts and implications: How does it affect costs of ANSPs?*

*CI Spreads lead to relevant uncertainty regarding costs for ANSPs (and FABs). The figures illustrate the CI conversion to ATCO employment costs in Mio. € (5-year prediction, 2019-2023). Fact: High uncertainties in costs for some ANSPs, e.g., for DFS, DSNA, ENAIRE and ENAV.*

TECHNISCHE UNIVERSITÄT DRESDEN

DRESDEN concept




*Data: Spring Report 2019. Illustration: IFL*
*The Accuracy of STATFOR Forecasts - Webinar*
*InterFAB ExpertTalks*
*TU Dresden, Institute of Logistics and Aviation /*
*Dr. Hartmut Fricke, Thomas Standfuß*
*ATM performance data - can we do better ? //*
*02.03.2021*

concluding non-homogeneous uncertainties for every flight zone. The research also found similar high uncertainty and variations in human resource requirements and ATCO employment costs between ANSPs.

TUD proposes supplementing STAFOR analysis with the Mean Average Percentage Error (MAPE) statistical value used by heterogenous industries with homogenous products such as ANSPs. MAPE compares predicted values with actual values to measure the forecast bias and applies qualitative indices to assess forecast accuracy, thereby adding a further technique to the existing STATFOR scores. When TUD tested the MAPE tool on STATFOR results with some slight adjustments to allow distinguishing between over- and underestimations, the research provided more precise information, for example tracking over-estimations in demand during the period 2011-2013, and the more recent under-estimations from

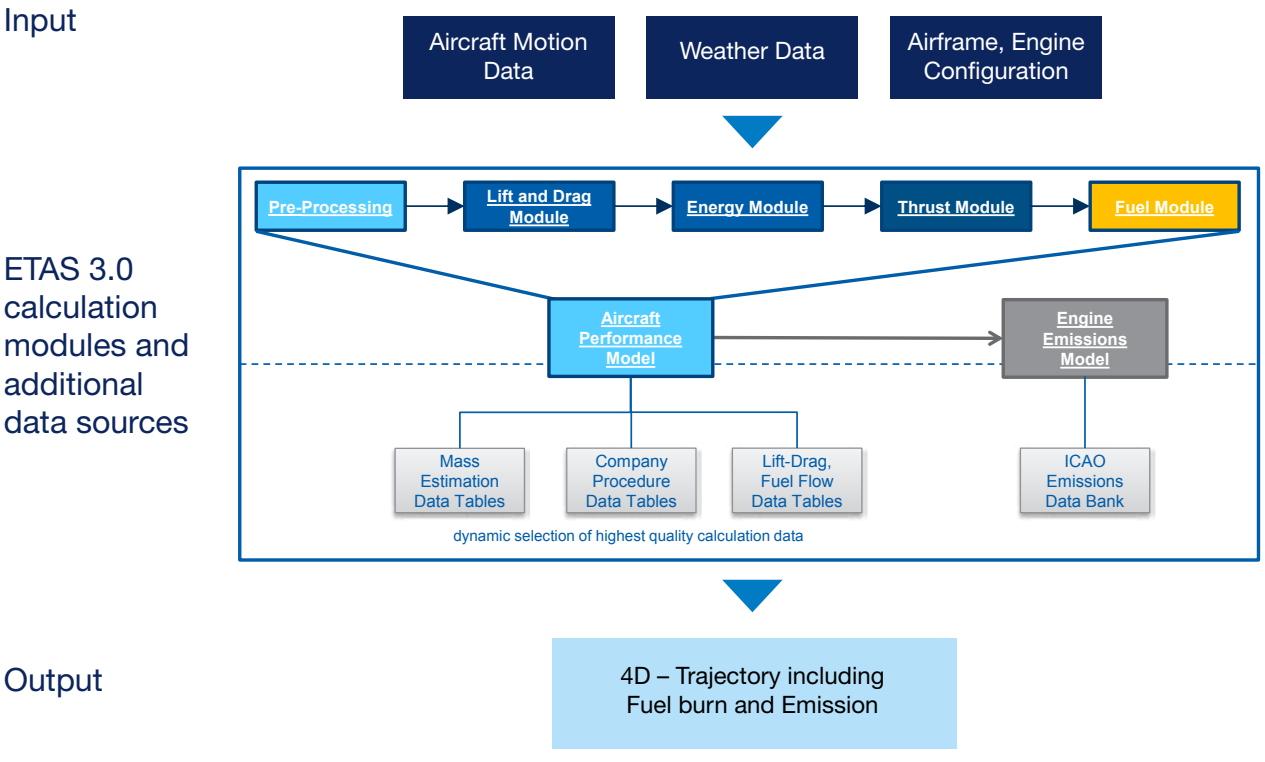
> *The high and low scenarios have negative consequences for ANSPs with regard to resource and cost planning.*
>
> **Prof Dr-Ing Hartmut Fricke**

2015-2018. It also found that delay increases exponentially with demand, showing a linear model to be inappropriate.

In conclusion, Prof Dr-Ing Fricke said STATFOR high and low scenarios have negative consequences for ANSPs with regard to resource and cost planning, however, there is an opportunity to introduce other quality indicators. MAPE is just one example of several techniques available. Looking ahead, the next decade presents many challenges as the industry recovers from the impact of COVID-19.

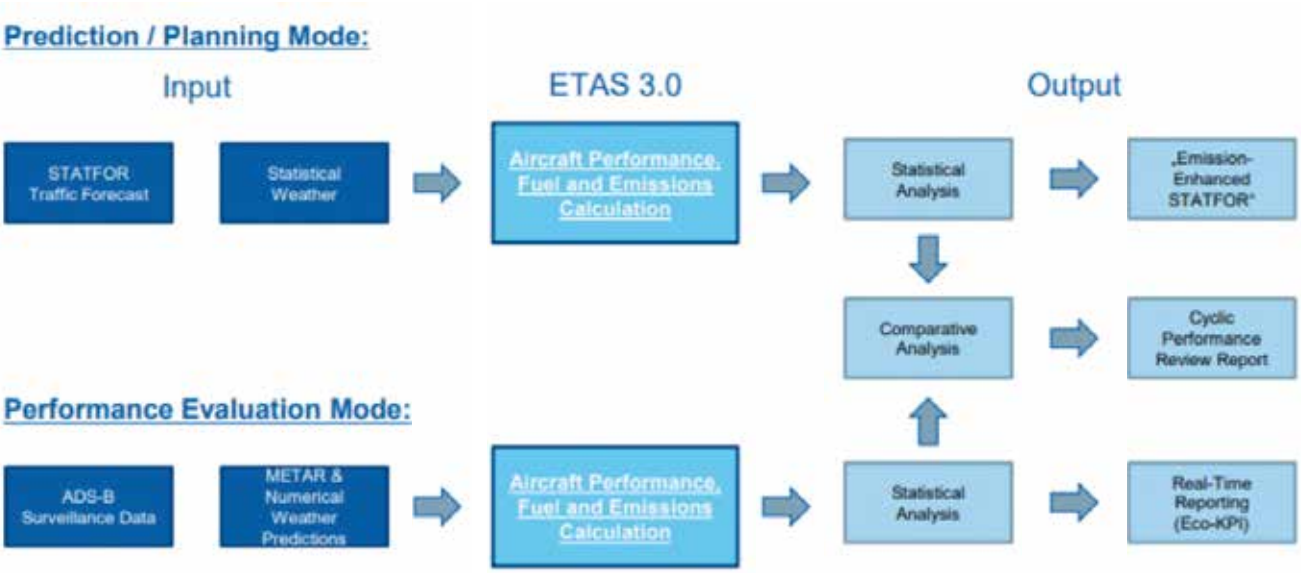
The performance scheme is already introducing new parameters around environmental performance and it is this focus on ecology that Prof. Fricke believes will add value to the existing airspace capacity, delay performance indicators, and, finally improved social acceptance of air transport for the decade to come.

## ETAS: How to link-in ecology in the STATFOR process (1)?



TUD proposes a fuel-consumption assessment system linked to the STATFOR forecast to allocate estimated emissions to the predicted flights (planning mode), and determined these same emissions based on real data along the performance assessment (evaluation mode). There is an example of this in Germany, where the DFS' Enhanced Trajectory Assessment System (ETAS) estimates emissions for thousands of overnight flights in German airspace since 2016 using standard aircraft track data (FANOMOS or ADS-B), weather data, and engine combinations verified against the ICAO emissions database. The result would be an enriched STATFOR forecast and performance assessment with real data such as surveillance information, emissions, staff costs and charging differences, providing a platform with strong environmental credentials for the years ahead as air traffic recovers from the pandemic.

## ETAS: How to link-in ecology in the STATFOR process (2)?




TECHNISCHE UNIVERSITÄT DRESDEN

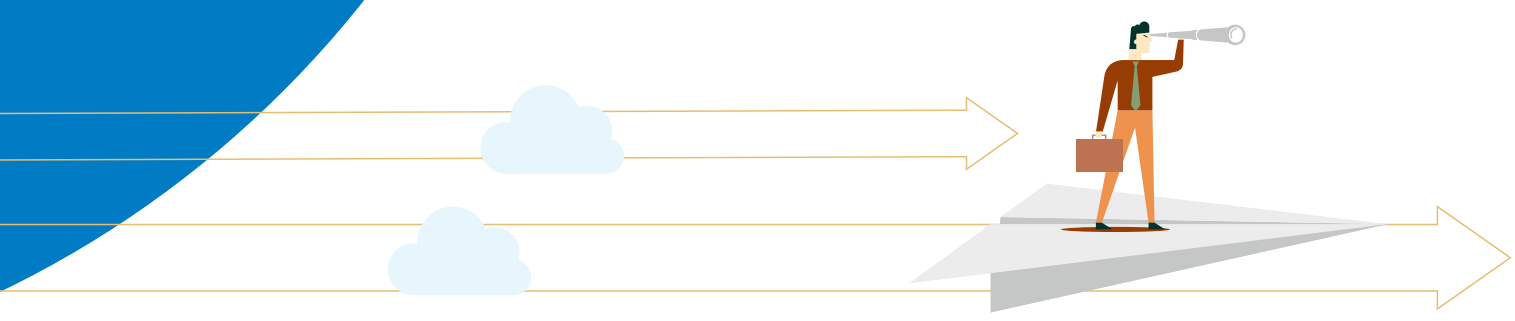
DRESDEN concept

*The Accuracy of STATFOR Forecasts - Webinar InterFAB ExpertTalks*
*TU Dresden, Institute of Logistics and Aviation / Dr. Hartmut Fricke, Thomas Standfuß*
*ATM performance data - can we do better ? // 02.03.2021*

Customer Contact: DFS OA/L - ATM Data & Services
frank.weber@dfs.de

# TALK 2

## Economic Surplus



The second InterFAB Expert Talk hosted by FABEC on 24 March 2021 and attended by more than 80 delegates from all over Europe addressed complexities surrounding the interpretation of financial data by the European Commission's Performance Review Body (PRB) and air navigation service providers (ANSPs). A presentation by Eckhard Drews, DFS Director Controlling, and Vitan Todorov, BULATSA Director Finance and Chief Accountant, explained how the term 'economic surplus' is interpreted very differently with profound repercussions on the reporting of financial results.

To illustrate the conundrum, Eckhard Drews showed the principle of the calculation of economic surplus by PRB and furthermore the transformation from the results of the statutory accounts to economic surplus. For some ANSPs there is a huge gap between both figures. For example, the economic surplus could show a positive result in the reporting, whereas the outcome of the statutory accounts may be negative.

The Expert Talk presented three different approaches to avoid misinterpretation of ANSP results. Firstly, there needs to be a recognition that costs may already exceed revenue in ANSP performance plans. Secondly, surplus should not be used by the PRB as representative of financial ANSP results. Thirdly, mixing planned and actual figures should not be relied upon to calculate the cost of capital.

## Our **EXPERTS**

**Eckhard Drews**
DFS Director Controlling

DFS Deutsche Flugsicherung

**Vitan Todorov**
BULATSA Director Finance
and Chief Accountant

BULATSA
BULGARIAN AIR TRAFFIC SERVICES AUTHORITY

In one example, the PRB monitoring report released in October 2020 refers to 'substantial surpluses' during the reference period which ANSPs do not have to return to airspace users. In this case, the PRB is expecting ANSPs to use so-called 'accumulated surplus' to manage the equity gap in 2020 and 2021 to reduce costs during the crisis.

There are additional factors to consider. Economic surplus can be positive or negative depending upon whether the costs to generate the output are higher or lower than the revenue. Furthermore, deviations from assumptions embedded in the performance plan can arise as a result of changes in forecast traffic volume and other risk-sharing mechanisms which take into account airspace capacity, punctuality and environmental performance.

## *Economic Surplus vs. annual statutory accounts (example)*

***The following example shows a huge deviation to the financial results:***

The PRB introduced the term ‘economic surplus’ in a balanced paper presented to the Single European Sky Committee in 2015 as it can be used as a proxy for early indication of the economic performance of the ANSP under a performance plan, but it does not state that this can be used by the not so deeply involved community to measure ‘money left’ to the ANSP. Furthermore, surpluses/losses should be measured versus the results embedded in the performance plan.

Subsequently economic surplus is analogous with economic profit rather than accounting profit and remains at variance with statutory terms. The PRB considers economic surplus as embedded in the cost of capital, whereas when calculating its value the PRB uses the weighted average cost of capital, which is a pre-tax value. Vitan Todorov argues the cost of equity is not a surplus by default but is part of the cost base, a factor recognised by ICAO.

> *We as ANSPs are often confronted by statements by the PRB that ANSPs are generating a lot of surplus, a term which is interpreted to mean profit.*
>
> **Eckhard Drews**

## *Transition annual statutory accounts to Economic Surplus (example)*

| *P&L - annual statutory accounts Mio. €* | **Statutory accounts** |
|---|---|
| **Revenues** | **70.0** |
| Staff costs | 50.0 |
| Operational Costs | 30.0 |
| Depreciation | 10.0 |
| Financial Expense | 10.0 |
| **Profit / Loss annual statutory accounts** | **-30.0** |

| *Transition Mio. €* | **Total (enroute and terminal)** |
|---|---|
| Annual statutory accounts (P&L) | -30.0 |
| Deviation revenue reduction targeted by the State | 50.0 |
| Uncontrollable costs | 10.0 |
| Bonus/Malus | 5.0 |
| **Economic Surplus (nominal)** | **35.0** |
| *Inflation index actual* | *110.9* |
| **Difference between nominal and real** | **-3.4** |
| **Economic Surplus real terms (PRB approach)** | **31.6** |

Huge difference between **statutory accounts** (-30.0 Mio. €) and **Economic Surplus** (+31.6 Mio. €) lead to miss-interpretations

> *It is good that the PRB has taken the initiative to invent this concept of economic surplus, but it would be useful to discuss in greater detail what it shows and how it can be used.*
>
> **Vitan Todorov**

A joint task force set up in September 2020, developed at InterFAB level with EUROCONTROL and the PRB, set in motion open and frank discussions to address these concerns.

In conclusion, the presenters called for indicators outlining the financial results of ANSPs which are closer to those of the statutory accounts. Of particular importance, they warned that substituting 'profit' in place of 'economic surplus' indicates ASNPs have accrued a financial surplus which might not have actually been the case.

## Calculation of Return on Equity (RoE) should be based on actual figures

| DFS 2017; in T€ | Performance Plan | Actual | Economic Surplus |
|---|---|---|---|
| Asset Base | 436,722 | 682,599 | 682,599 |
| Return on Equity | 7.45% | 5.23% | 7.45% |
| Result | 32,536 | 35,728 | 50,854 |

**No mix of actual (such as asset base) and planned (percentage of Return on Equity) figures for the calculation of Cost of Capital**

**Calculation of PRB shows a totally different RoE compared to the real accounts.**

**The 'virtual RoE' shown in the official Monitoring Report (see on the right) might lead to misunderstanding and wrong conclusions:**

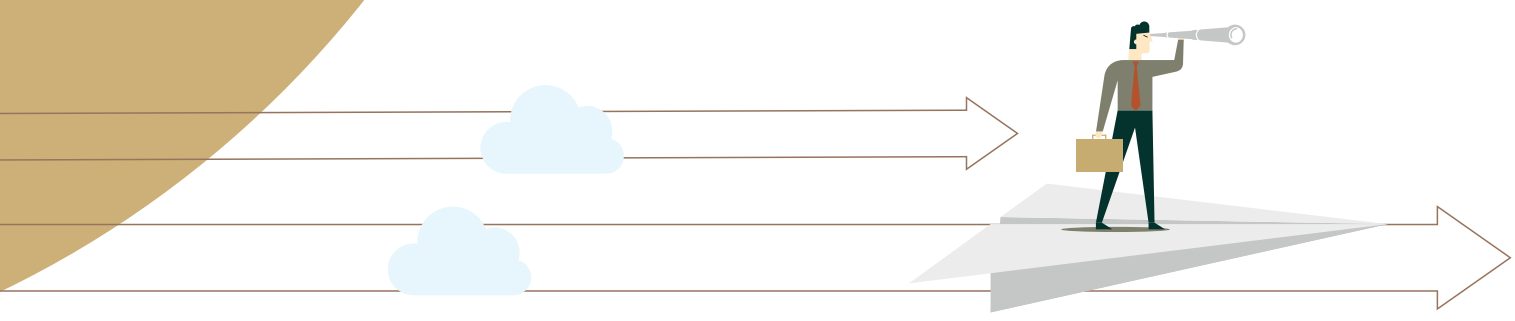
| ATSP estimated surplus ('000 €2008) based on actual data from Reporting Tables | 2015A | 2016A | 2017A |
|---|---|---|---|
| Total asset base | 1 397 725 | 1 457 775 | 1 471 128 |
| Estimated proportion of financing through equity (in %) | 34.1% | 39.6% | 46.4% |
| Estimated proportion of financing through equity (in value) | 476 728 | 577 082 | 682 599 |
| Estimated proportion of financing through debt (in %) | 65.9% | 60.4% | 53.6% |
| Estimated proportion of financing through debt (in value) | 920 997 | 880 693 | 788 529 |
| Cost of capital pre-tax (in value) | 62 663 | 67 784 | 63 633 |
| Average interest on debt (in %) | 2.9% | 2.8% | 1.6% |
| Interest on debt (in value) | 27 147 | 24 791 | 12 779 |
| Determined RoE pre-tax rate (in %) | 7.5% | 7.5% | 7.5% |
| Estimated surplus embedded in the cost of capital for en-route (in value) | 35 516 | 42 993 | 50 854 |
| Net ATSP gain(+)/loss(-) on en-route activity | 57 195 | 70 714 | 69 361 |
| Overall estimated surplus (+/-) for the en-route activity | 92 712 | 113 706 | |
| Revenue/costs for the en-route activity | 819 320 | 774 473 | 738 418 |
| Estimated surplus (+/-) in percent of en-route revenues | 11.3% | 14.7% | 18.3% |
| Estimated ex-post RoE pre-tax rate (in %) | 19.4% | 18.7% | 17.6% |

## Conclusion – Economic Surplus method …

- is very technical and only at expert level fully comprehensible,
- is still a misunderstood concept which differs strongly from the legal books,
- is transferred in publications into the better known term ‘profit’ thus indicating that ANSPs have had an enormous of surplus,
- should be indicative to show what was generated in excess to the Performance Plan and ensure consistency with the annual reports,
- is no requirement resulting from regulation but an indicator invented by PRB,
- There is a need to improve the message with the target to avoid confusion as financial experts need to translate and interpret the data to decision makers.

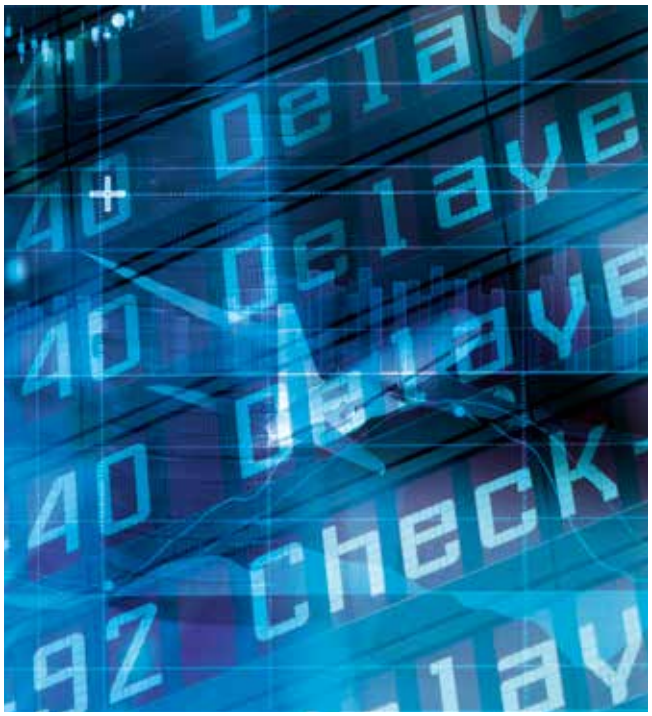
# TALK 3

## Cost of delay



The third InterFAB Expert Talk, hosted by FABEC on 20 April 2021, identified inaccuracies in the calculation of the cost of delay arising from the use of outdated methodology developed in Europe nearly 20 years ago. The results of a simulated exercise were presented to assess more accurately the cost of Air Traffic Flow Management (ATFM) delay. Compiling reliable performance data enables airlines, air navigation service providers (ANSPs) and political decision-makers to plan capacity and resources more effectively in response to demand.

Giuseppe Antonio Gangemi, Head of Performance Analysis for the Italian air navigation service provider (ANSP) ENAV, shared the results of a study conducted by ENAV using the new methodology. Taking all the ECAC flight data from 2012 to 2019, ENAV analysed delay distribution and duration to calculate the cost per minute for different classes of delay. The analysis identified an error of aggregation in the current calculation of the cost of delay of 12.9 percent, resulting in a difference of 860 million euros for the years from 2017 to 2019.




## Our **EXPERT**

**Giuseppe Antonio Gangemi**

ENAV Head of Performance Analysis, and moderated by Ibon Galarraga, Research Professor at the Basque Centre for Climate Change

enav

”

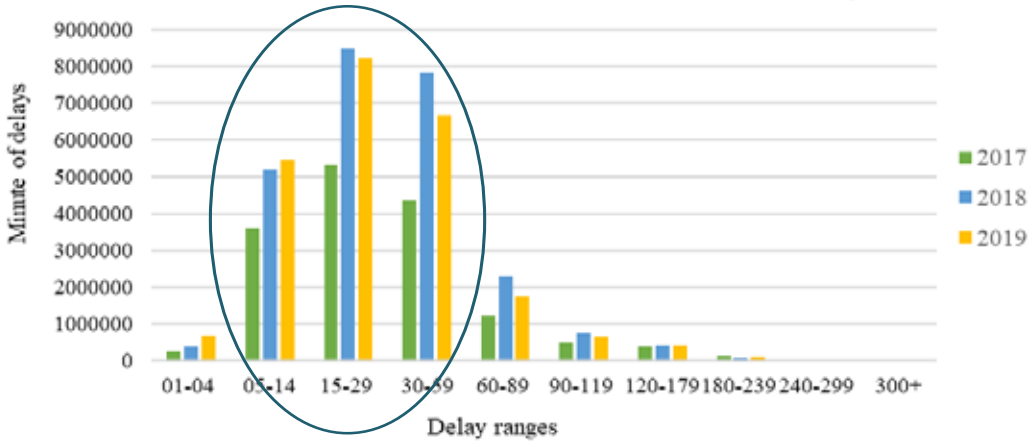
*Using an average value is a valid approximation for pre-operational decision making, but when assessing the level of performance in the post-operations phase, a more accurate calculation for the cost of delay has to be used to avoid biased calculations.*

The reason for this difference is that in official publications such as the Performance Review Report (PRR) and Air Traffic Cost Effectiveness (ACE) report, an average value of 102 euro per minute of ATFM delay, irrespective of the length of the delay, is considered. This value is based on the most recent update (2018) of the University of Westminster Transport Studies Group analysis (2003). Post-operational data shows that most of the ATFM delay is less than 30 minutes – showing the usage of the average value does not reflect the real value of delay cost.

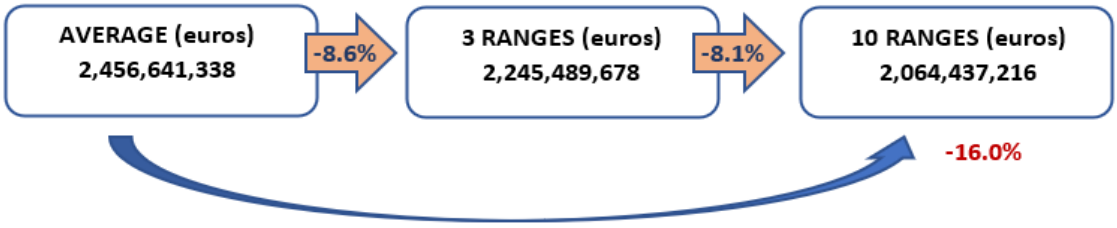
Delay is not easy to understand and takes different forms. For example, schedule buffers may be applied to compensate for tactical delay such as strong headwind and secondary delay can arise as a result of late arrival from a previous flight. Different types of delay have different cost values; for example,

## *Delayed flight distribution using Post-OPS Data*

***Distribution of flights across the delay ranges***




*Source: own elaboration based on EUROCONTROL data*



allocating delay on the ground is cheaper and safer than once airborne. Single-flight cost data would provide more accurate analysis, but airline sensitivity means these data cannot be analysed.

The advantage of the new indicator is to override limitations of current methodology that considers only departure delay and does not consider the overarching objective of a punctual arrival. ENAV applied the new adjusted indicator in a simulation using a selection of flights operating in BLUE MED skies (airspace of Cyprus, Greece, Italy and Malta which together accounted for about 12% of total ECAC flights) between 2012 and 2020. The results showed a 10% reduction in the cost of delay when the difference between actual in-flight time and estimated flight duration was considered, equivalent to approximately 4.7 million euros per year.

”

*Delays cost millions of euros for airlines and passengers, therefore a better measurement of timekeeping performance at several points can allow the identification and mitigation of inefficiencies.*

**Giuseppe Gangemi**

*The use of an average value fro the cost of one minute of delay tends to potentially coat the real value of the delay cost.*

| 2019 | Average | 3 ranges | Var (%) | 10 ranges | Var (%) |
|---|---|---|---|---|---|
| **Baltic** | 26.865.678 | 17.542.992 | -34,7% | 15.678.144 | -41,6% |
| **Blue Med** | 195.498.810 | 199.126.984 | 1,9% | 185.379.881 | -5,2% |
| **Danish-Swedish** | 12.941.454 | 13.517.068 | 4,4% | 12.768.655 | -1,3% |
| **Danube** | 9.781.698 | 6.966.963 | -28,8% | 6.391.474 | -34,7% |
| **FAB CE** | 447.012.348 | 370.221.921 | -17,2% | 339.890.275 | -24,0% |
| **Fabec** | 1.244.319.318 | 1.132.220.437 | -9,0% | 1.039.111.985 | -16,5% |
| **NEFAB** | 8.375.424 | 6.441.663 | -23,1% | 6.133.197 | -26,8% |
| **SW_FAB** | 287.103.786 | 270.627.464 | -5,7% | 249.526.304 | -13,1% |
| **UK-IR_FAB** | 169.715.658 | 173.504.950 | 2,2% | 157.806.328 | -7,0% |
| **NOT_A_FAB** | 55.028.184 | 55.280.343 | 0,5% | 51.750.973 | -6,0% |
| **TOTAL FABs** | 2.456.642.358 | 2.245.450.785 | -8,6% | 2.064.437.216 | -16,0% |

”

*The aim of the research is not to reinvent the wheel rather to further improve the quality of services based on a better understanding. In this light we have assessed more accurately the cost of ATFM delay in Europe to gain a deeper understanding of the actual delay distribution between 2012 and 2019.*

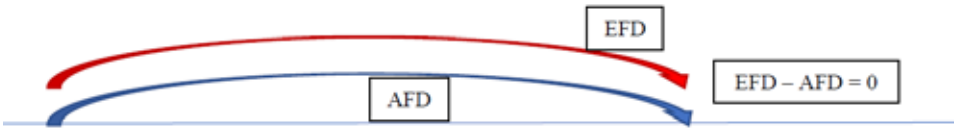
**Giuseppe Gangemi**

The Expert Talk was attended by more than 70 delegates from all over Europe and generated detailed discussion about different methodologies used to assess the cost of ATFM delay. Highlighting the importance of ATM performance monitoring and measurement, participants learned of the availability of disclosed data and recognised the need for more detailed research to be carried out to improve the calculation of ATFM delay.

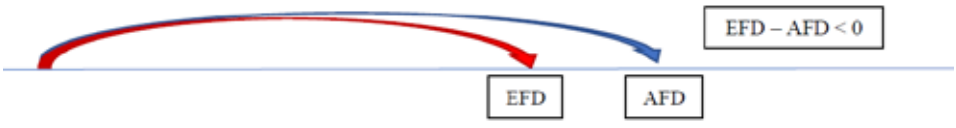
## Adjusted delay: Methodology

Compare the **Actual Flight Duratin (AFD)** of each flight against its **Estimated Flight duration (EFD)**.
Depending on the result, the initial (ATFM) delay can be:

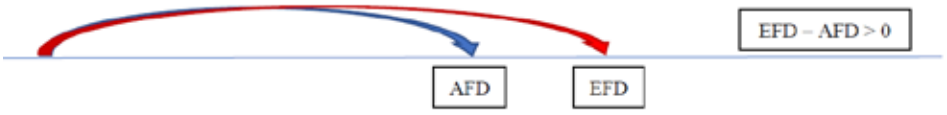
Unchanged delay




Increased delay

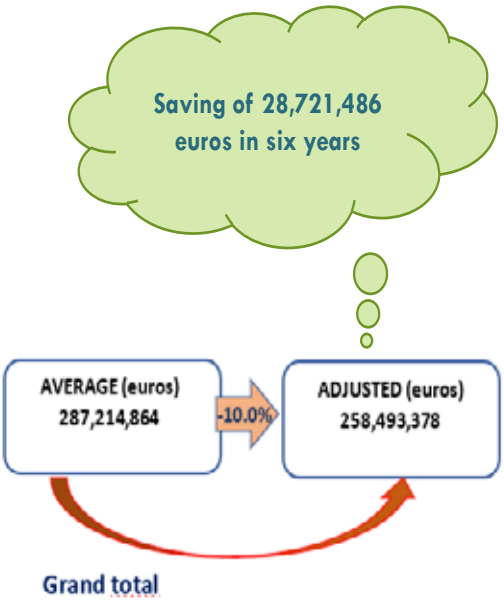



Reduced delay



The following formula was used to calculate the indicator

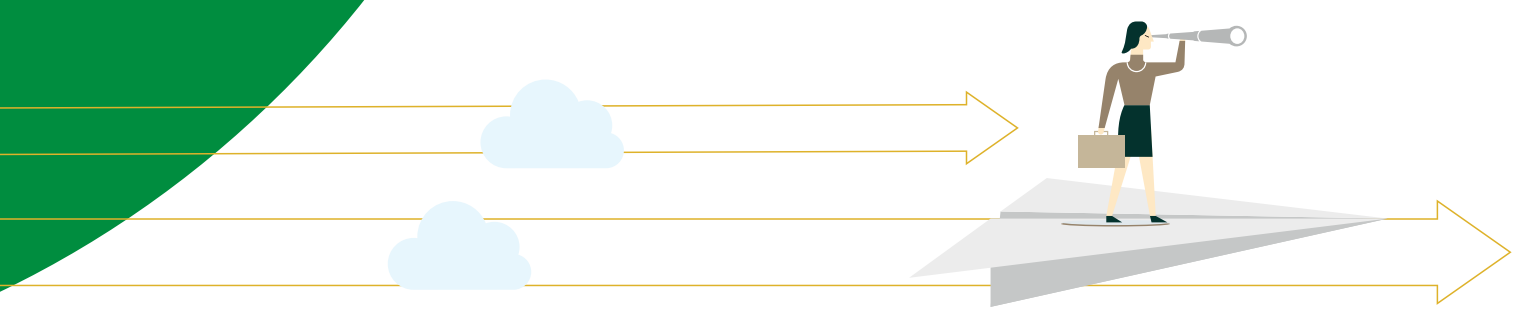
| ATFM delay 1-14 min (FDD>0) | | | |
|---|---|---|---|
| YEAR | Σ AAD (min.) | Σ ATFM delay (min.) | AADi (%) |
| 2015 | -7475 | 313928 | -2% |
| 2016 | -5977 | 248476 | -2% |
| 2017 | 39497 | 376451 | 10% |
| 2018 | 116545 | 816211 | 14% |
| 2019 | 124218 | 995247 | 12% |
| 2020 | 15357 | 65519 | 23% |
| Total | 282165 | 2815832 | 10% |




*Source: own elaboration based on data from EUROCONTROL. Sample of Blue Med Flights from 2015 to 2020*

# TALK 4

## Climate change and the role of ATM



Transportation accounts for a quarter of EU greenhouse gas emissions[1], prompting aviation to seek ways of reducing its 5% contribution across ground-based and airborne sectors. Focus to date has been on decreasing carbon dioxide ($CO_2$), however new research by the German Aerospace Centre (DLR) suggests $CO_2$ is responsible for less than half of airborne emissions. Significantly, the climate impact and lifetime of non-$CO_2$ products varies considerably depending upon altitude, latitude and local weather conditions. Understanding how and where aviation emissions occur was the subject of InterFAB's fourth Expert Talk hosted by BALTIC FAB on 11 May 2021, along with opportunities to mitigate both $CO_2$ and non-$CO_2$ emissions.

[1]*Transport accounts for a quarter of EU greenhouse gas emissions, European Green https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en*

## Our **EXPERT**

**Dr Sigrun Matthes**
and Volker Grewe, Deutsches Zentrum für Luft- und Raumfahrt (DLR) Institute of Atmospheric Physics, and moderated by Egle Merkiene, Oro Navigacija Head of Strategic Development and International Programmes, on 11 May 2021

DLR

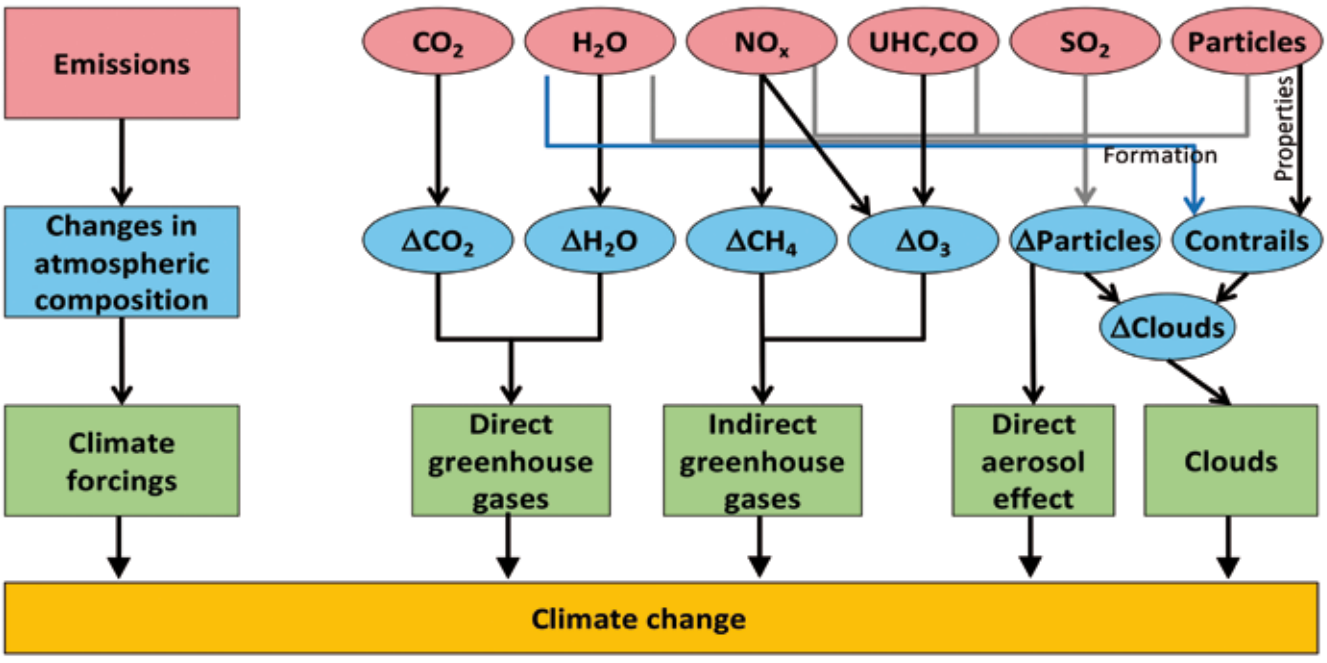
”

*We are working to develop algorithms which will allow us, with a meteorological forecast and an algorithm, to produce a forecast of the climate change function for the next day, and the next three days. We want to see how much we could gain on an individual trajectory.*

Dr Sigrun Matthes from the DLR Institute of Atmospheric Physics explained fossil fuel combustion releases a series of exhausts gases into the atmosphere which have direct and indirect climate impact. Contrails provide visible evidence of water emissions, while bi-products including carbon dioxide ($CO_2$), nitrogen dioxide ($NO_2$), sulphur dioxide ($SO_2$), carbon monoxide (CO) and soot particles have the chemical potential to introduce a change in atmospheric composition. Altering the radiative balance of the atmosphere has a climate forcing impact referred to as Effective Radiative Forcing (ERF) which can at times have a warming effect, or on other occasions a cooling effect.

A detailed simulation conducted by DLR linked aircraft trajectories with eight typical weather patterns in the North Atlantic to assess impact variations associated with synoptic weather patterns. For example, NOx influences atmospheric components such as ozone which in turn may have a

## *Overview: Climate impact of aviation*



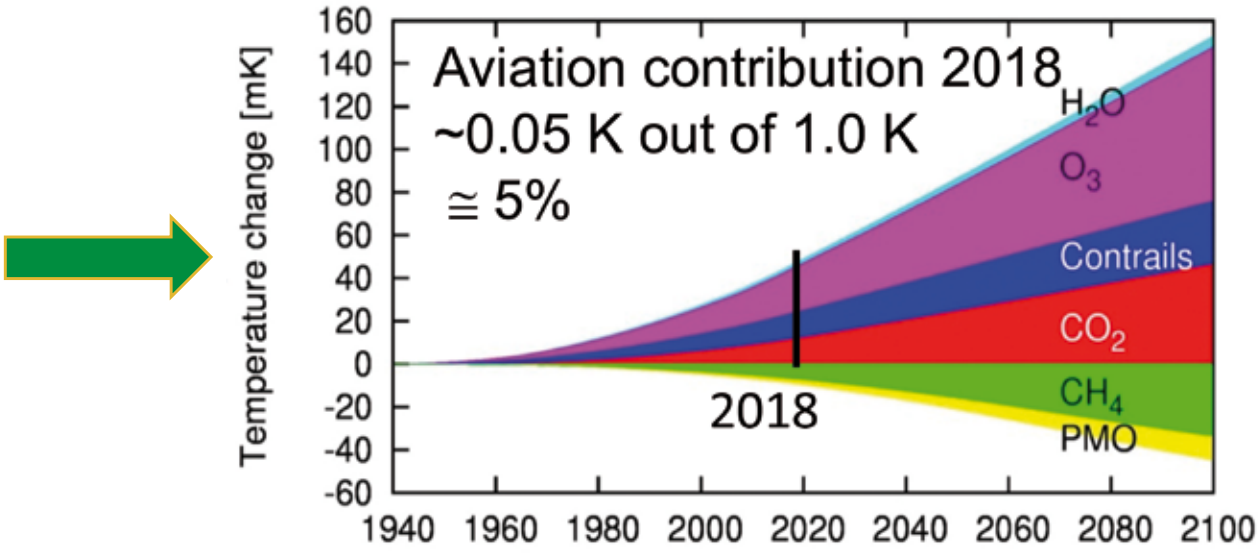
greenhouse gas effect, while the interaction between aerosols and clouds reduces the warming impact of ozone. These algorithmic climate change tools can help manage potential perturbation, for example by minimising ozone production in the tropics where radiation is high in comparison with mid-latitudes. DLR has developed a 'climate sensitivity parameter' to measure the effects of different products on the radiative balance of the atmosphere according to spatial and temporal parameters.

The development of multi-dimensional multi-criteria optimisation algorithms with the ability to forecast climate impact with reference to meteorological data and aircraft trajectories forms part of broader SESAR research[2]. The aim is to demonstrate sufficient robustness to be sure climate-optimised

[2] *SESAR research projects include: FLYATM4E; ALARM; DYNCAT; ACACIA; ClimOP. www.sesarju.*

> *Fuel inefficiencies and CO2 emissions decrease at higher altitudes. In contrast, the non-CO2 effects of water vapour, NOx and contrails are all reduced at lower altitudes. There is a strong vertical dependence that shows changing flight altitude can help to mitigate climate impact, but many factors influence this non-linear relationship.*
>
> **Dr Sigrun Matthes**

## *Temperature change*




***More than 50% of the aviation's climate impact results from non-CO2 effects***

”

*When it comes to altitude and location dependent information and the more spatial and temporal resolution you need to do, the more complicated it becomes. Non-$CO_2$ effects alter according to their location so there is no single factor. Finding the right balance to enable stakeholders to account for climate-optimised trajectories will be key to making them attractive to users.*

**Dr Sigrun Matthes**

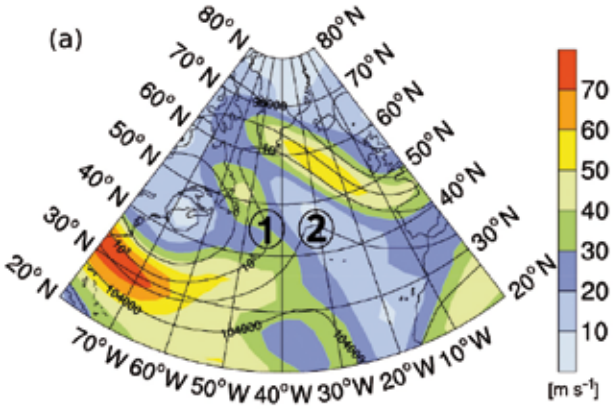
trajectories perform better, or at least as well as, the fuel-optimum in a scientific way and enable airspace users to combine with existing measures including Jetstream benefits.

In addition to meteorological components, the concept also needs services such as System Wide Information Management (SWIM) and Electronic Flight Bag (EFB) capability on board the aircraft to support flight planning and easy execution of procedures. Additional research is looking at how the concept could be integrated into an expanded ATM system and how it would interface, for example, with military airspace.

Establishing a way of monitoring, reporting and verifying the process is also important, especially if it is to become part of the current emissions trading scheme, or global CORSIA agreement. Market-based mechanisms could play a part in any risk analysis used to determine the selection or otherwise of climate-optimised trajectories.

## What is the relation between weather and aviation $NO_x$ climate impact?

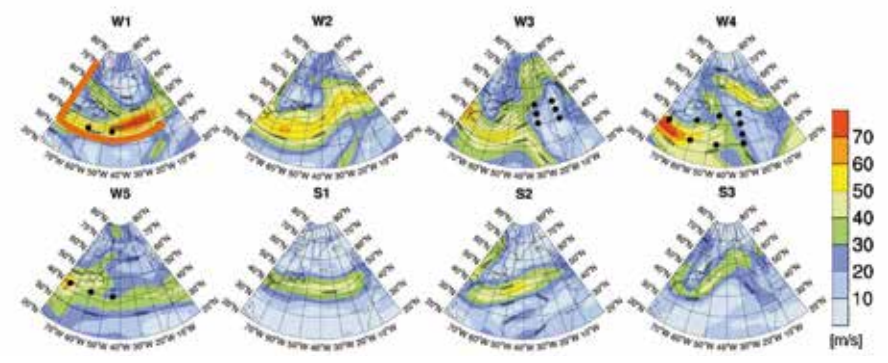
### Weather

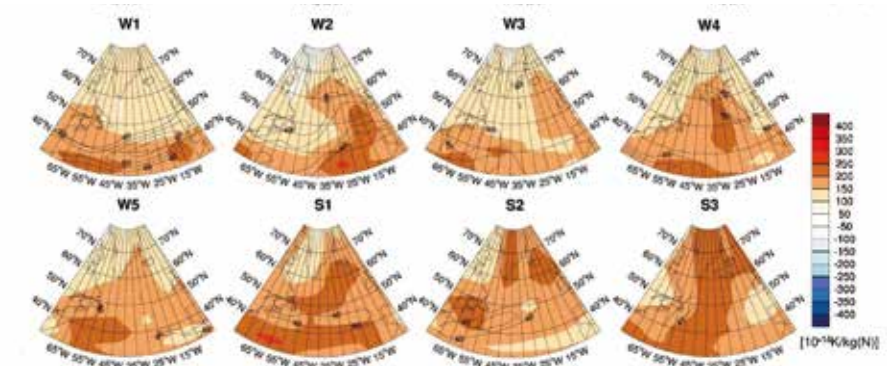



### Aviation NOx - RF

Topics discussed during the InterFAB Expert Talk on Climate Change and Role of ATM will be explored in more detailed during a research workshop with the same title which takes place from 22-23 September 2021 in Vilnius, Lithuania. The InterFAB event is organised in partnership with Vilnius Gedimino Technical University and the German Aviation Research Society (G.A.R.S). For more information, please visit: www.fabec.eu

## Weather data and Ozone Climate-Change-Functions




Frömming et al. 2021

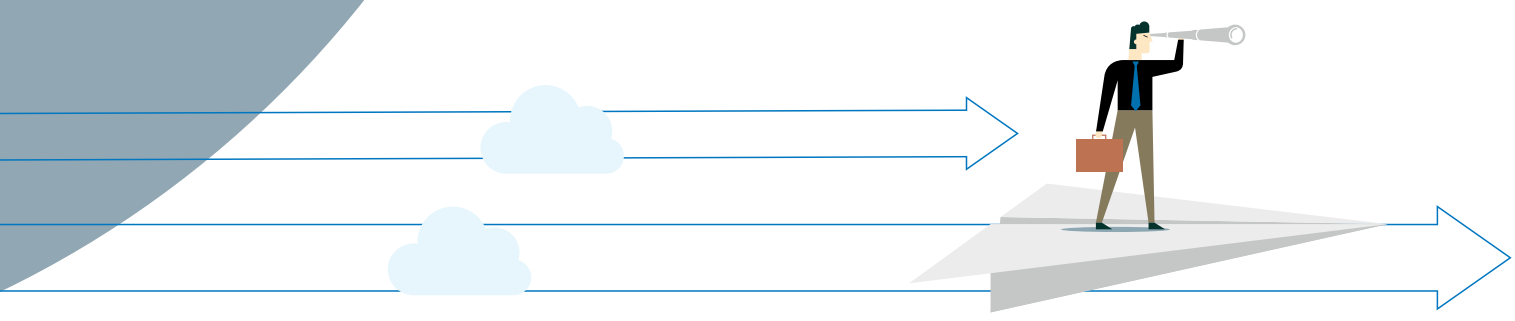
**Climatology of aviation weather situations:**
Winter W1-W5
Summer S1-S3
University Reading
Irvine et al. 2013

**Contribution of a local $NO_x$ emission to climate change via ozone formation**

**Clear relationship between weather and CCFs**

# TALK 5

## Volatility in air traffic – a growing challenge for the aviation sector



Unexpected geopolitical events, extreme weather and shifting passenger preferences make traffic forecasting difficult. The increase in these events presents resource challenges for Air Navigation Service Providers (ANSPs) who rely on demand forecasts to plan infrastructure investment, typically over five to seven year' cycles. In the fifth InterFAB Expert Talk on 24 June 2021, hosted by FAB CE, industry experts came together to discuss volatility in air traffic and the delivery of cost-effective services in the aftermath of COVID-19.

Unaided by government subsidies ANSPs reduced costs wherever possible during COVID-19, for example through the introduction of new rosters, multi-sector ratings and adapting shift patterns to maintain critical air traffic services. Downtime was used to boost skills training and technological research continued in anticipation of returning traffic. However, predicting the volume of traffic, when and where it will grow fastest remains a challenge.

## Our **EXPERTS**

**Alexander Hanslik**

AustroControl Director Corporate Strategy and International Affairs

austro CONTROL

**Matej Eljon**

FAB CE Aviation Services Director

FABCE AIRSPACE ALLIANCE


**Jozsef Bakos**

HungaroControl Head of Air Traffic Services

HungaroControl

"The most recent indicates demand could reach 90% of 2019 levels for the south-east axis compared with 60% three months' ago, which makes it very difficult to plan." Additional demand over and above 2019 volume would be hard to accommodate with existing resources.

He said SESAR and Single European Sky (SES) should focus on an infrastructural renewal programme that enhances system capacity as a whole. "If we do that in an efficient manner, the question of whether or not traffic forecasts are accurate to the last decimal point becomes less important. "There is a lot of flexibility in our systems to respond to volatility as long as the demand does not hit system capacity limits. Five-year plans are not wrong, but they are only part of the story. There has to be flexibility to respond to changes in demand."

Measures such as improved trajectory planning, better slot management and crucially big data analysis are part of the solution. "The statistics we get now do not really tell the truth." He added that efforts to manage demand and supply need to be developed in partnership with the airlines as part of a wider discussion where problem solving takes place at Network Management level, regional or even local level.

Technological improvement is going to play a major role as a result of the digital transformation taking place in ATM, according to Matej Eljon, FAB CE Aviation Services Director.

SESAR is developing data sharing systems to support tactical planning by ANSPs and airspace users to help expand access to real-time data across national borders. This integrated approach is also reflected in the Network Manager's new data centric system architecture which is due to be operational by the end of the decade.

Enhanced network performance also supports implementation of free route airspace currently underway in Europe. Free route increases flight planning freedom for airspace users, however it also raises volatility at a local level as "routes between city pairs change multiple times a day" said Jozsef Bakos. "There is a bigger role for the Network Manager here."

> *ANSPs have a much more elastic cost structure as a consequence of COVID, for example directing capacity where needed in response to the short-term forecast. Digital transformation will enable more data to be exchanged across borders, more static and dynamic sector changes, cross border optimisations and expanded free route airspace. All this will have a significant impact on ANSP flexibility. Now is exactly the time to start working with these concepts.*
>
> **Matej Eljon**

In response to questions to the panel, the experts discussed the interdependencies that exist between key performance indicators such as airspace capacity and environmental performance. “There is a trade-off,” said Alexander Hanslik. “You cannot design a system that is only ready for one scenario: Protecting the environment comes with a cost. You need a buffer and this means that interdependencies between indicators need to play a bigger role in the target setting process.”

The STATFOR forecast predicts a return to 2019 traffic volume by 2024. This leaves ANSPs three years to develop a performance measurement scheme which is able to respond to demand changes in the short term and meet the industry’s longer-term objectives. Incentivizing greater flexibility in the delivery of air traffic services would be a good place to start.

”

*Just in the last six months the STATFOR forecast has changed three times.*

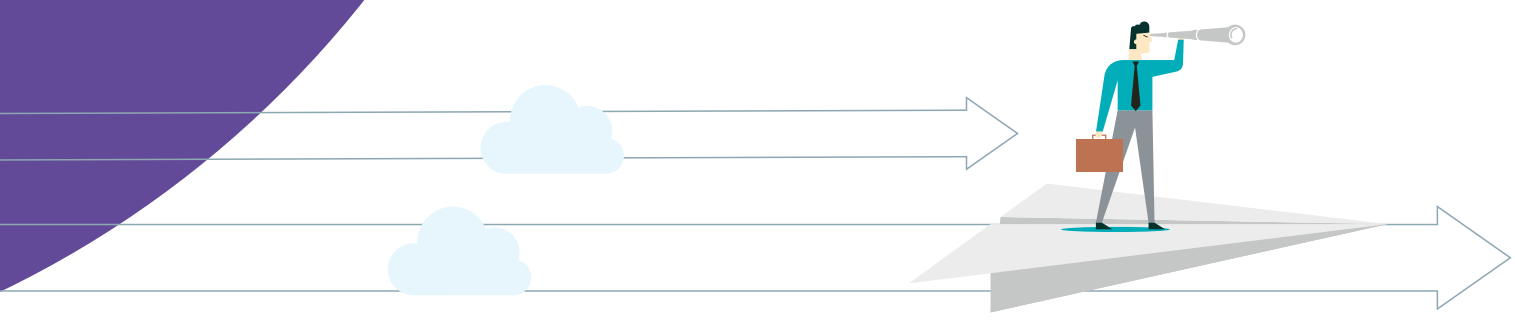
**Jozsef Bakos**

*The more objective data we have, the better.*

**Alexander Hanslik**

# TALK 6

## Traffic forecasts, delay and costs: A backcasting exercise



Air Navigation Service Providers (ANSPs) rely on forecasts to plan resources, staffing and capital investment programmes. EUROCONTROL STATFOR prepares traffic forecasts by working with stakeholders to determine low, medium and high traffic scenarios looking up to seven years into the future. At the FABEC Expert Talk on forecast accuracy in March 2021, Director of the Institute of Logistics and Aviation at TU Dresden, Faculty of Traffic Sciences, Prof Dr-Ing Hartmut Fricke highlighted significant differences between forecast traffic and actual throughput in individual states across Europe. This bias, leading to uncertainty in resource planning, may impact service levels for airspace users and have significant economic consequences for ANSPs. In the case of underestimation (actual traffic is higher than forecast) the probability of delay is likely to increase, while overestimation (actual traffic is lower than forecast) will result in higher capital expenditure.

## Our **EXPERTS**

**Dr Thomas Standfuß**

Technische Universität Dresden

TECHNISCHE UNIVERSITÄT DRESDEN

**Dr Ibon Galarraga**

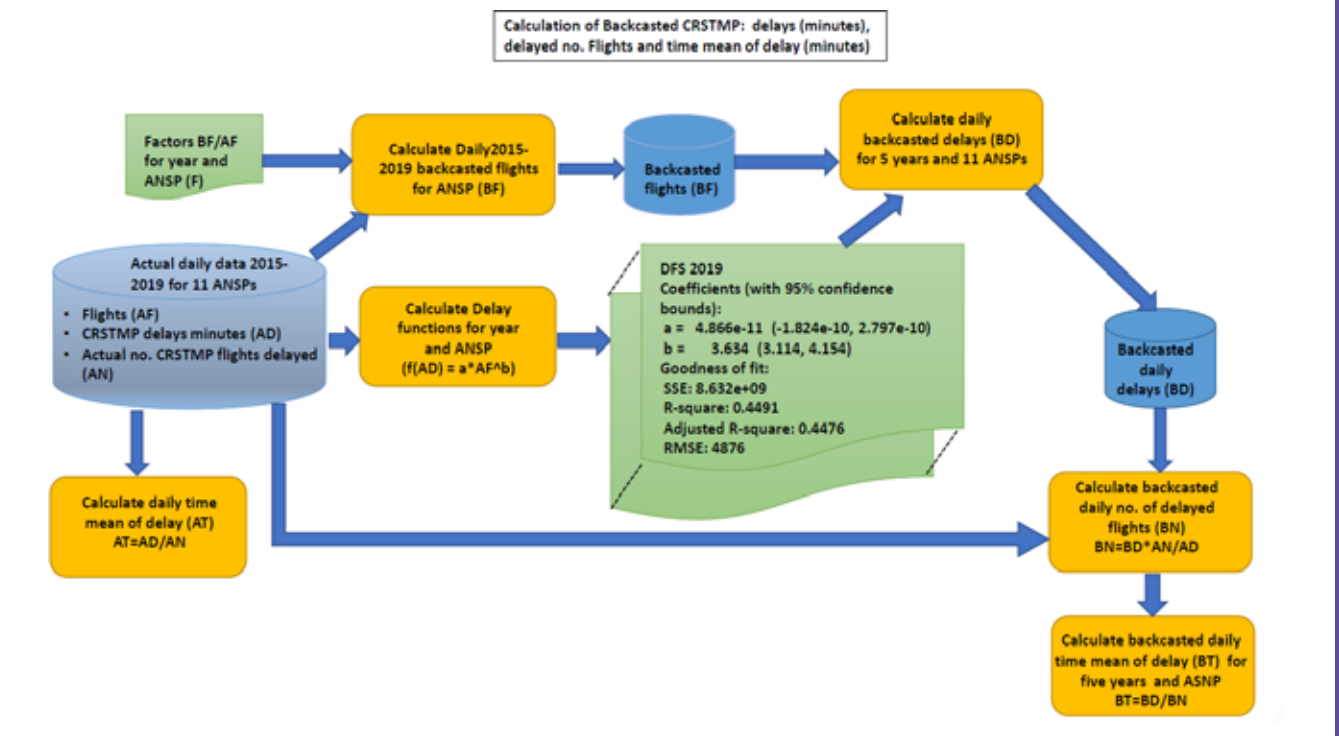
BC 3 Basque Centre for Climate Change and Metroeconomica

Metroeconomica

The FABEC Expert Talk on 8 September 2021 entitled: 'Traffic forecasts, delay and costs: a backcasting exercise' reviewed new research conducted by BC3, Metroeconomica, FABEC and TU Dresden which measures the consequences of low forecast quality. The research compared actual traffic with predicted traffic to assess the extent to which forecasting errors influence service quality in terms of delay and subsequent additional costs for the ATM system between 2015-2019.

The backcasting exercise sourced data from STATFOR, the Performance Review Unit (PRU) and ANSP performance plans in saturated airspaces in Europe. It used common PRU delay causes – namely ATC Capacity, ATC Routing, ATC Staffing, ATC Equipment, airspace Management and sPecial events (CRSTMP) – and measured the difference between actual delay (i.e. the delay that actually occurred) and backcasted

## *Calculating Backcasted CRSTMP delays (minutes, number of flights)*



delay (i.e. the delay that may have happened in case the forecast was correct) as well as the subsequent costs. Several different methods were employed to analyse the data.

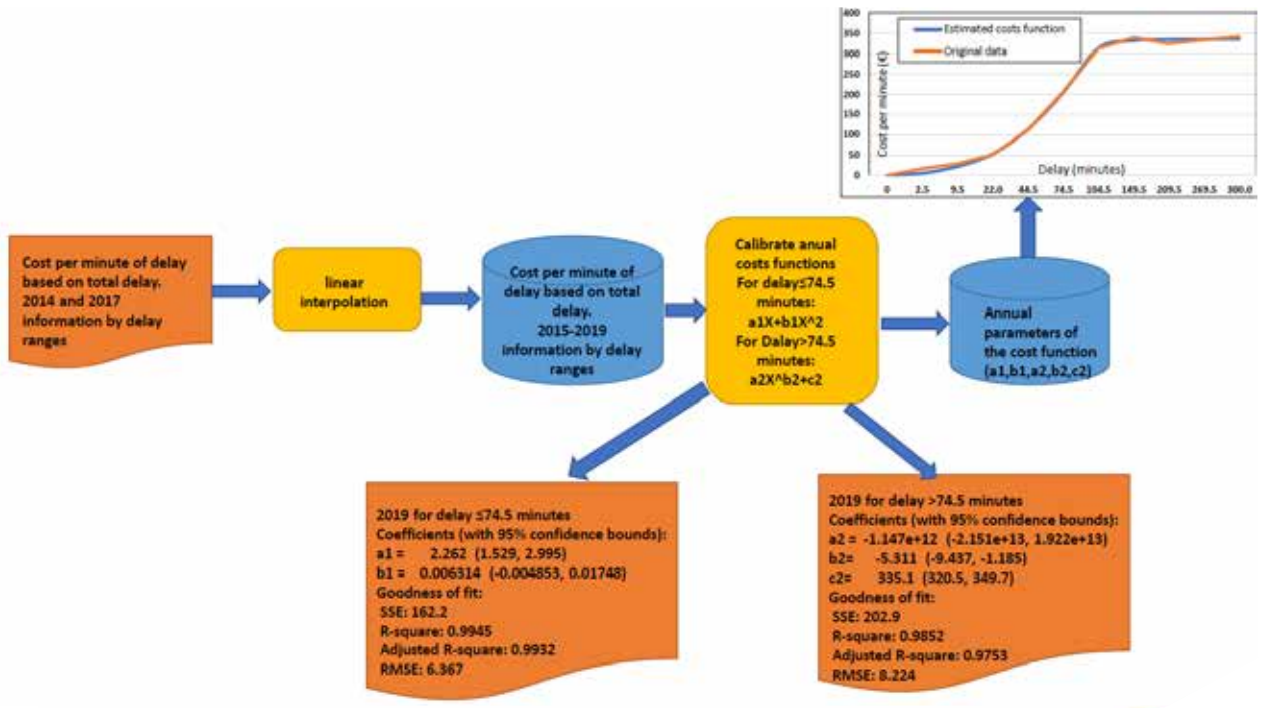
Initial analysis clustered flights into classes to calculate average delay minutes (ADM) and the probability of a mismatch with the target level of delay. This showed CRSTMP delay minutes to increase exponentially between 2015 and 2019, a period that saw actual traffic rise 8%, significantly above the 3.4% forecast.

Establishing a functional relationship for the ADM curve allows a calculation (backcast) to measure the delay and subsequent costs by reducing the (actual) demand to the forecasted.

A second iteration removed flight clustering and estimated mathematical functions for delays for each ANSP by year

> *Airspace users in reality experienced an extra 12.5 million minutes of extra delay as a direct result of forecast biases.*
>
> **Dr Thomas Standfuß**

## *Estimating Cost Functions*



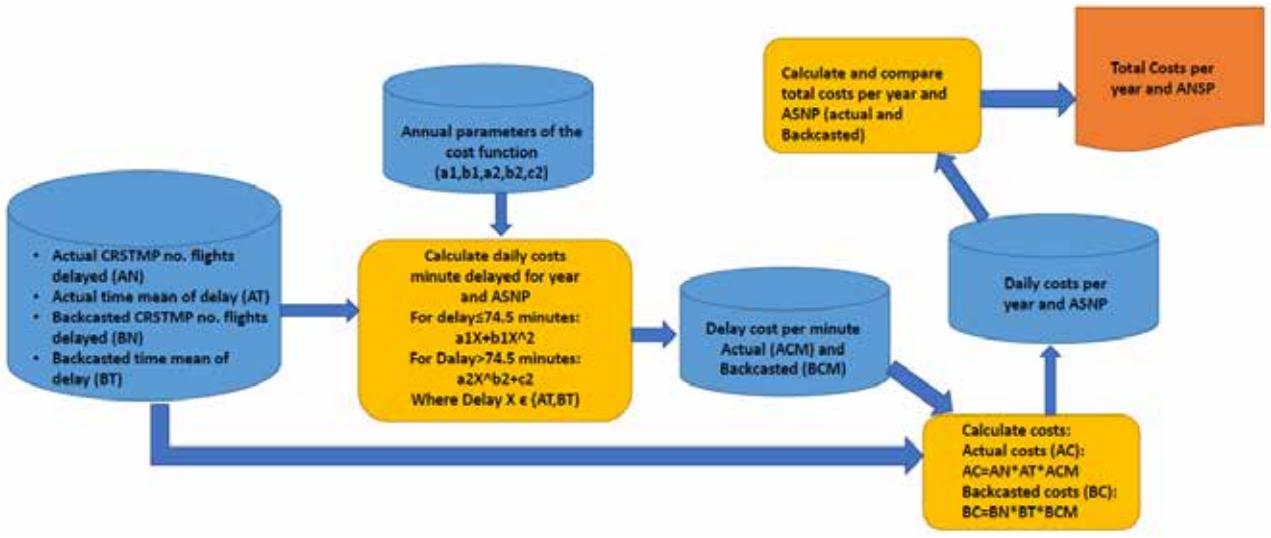
> *The delays that "actually" occurred were much higher than the forecasted ones.*
>
> **Dr Ibon Galarraga**

over the five-year period, increasing the accuracy of the estimations. Obtaining a mean time of delay revealed backcasted delays to be lower than CRSTMP delays in almost all cases, in some cases reduced almost by half. That is, the delays that "actually" occurred were much higher than the forecasted ones.

To measure subsequent financial impact, the analysis used the number of flights delayed due to forecast quality and, through an estimated mathematical function for the data on costs per minute from the University of Westminster, calculated the financial cost. As backcasted delays were lower than CRSTMP delays the cost of delays were also lower. The results showed that the underestimation of forecast traffic levels resulted in a 200% increase in cost across the saturated airspace.

In conclusion, initial research found that backcasted delays (i.e.those that would have occurred if STATFOR forecast

## Application of cost functions to CRSTMP Delays and Backcasted Delays

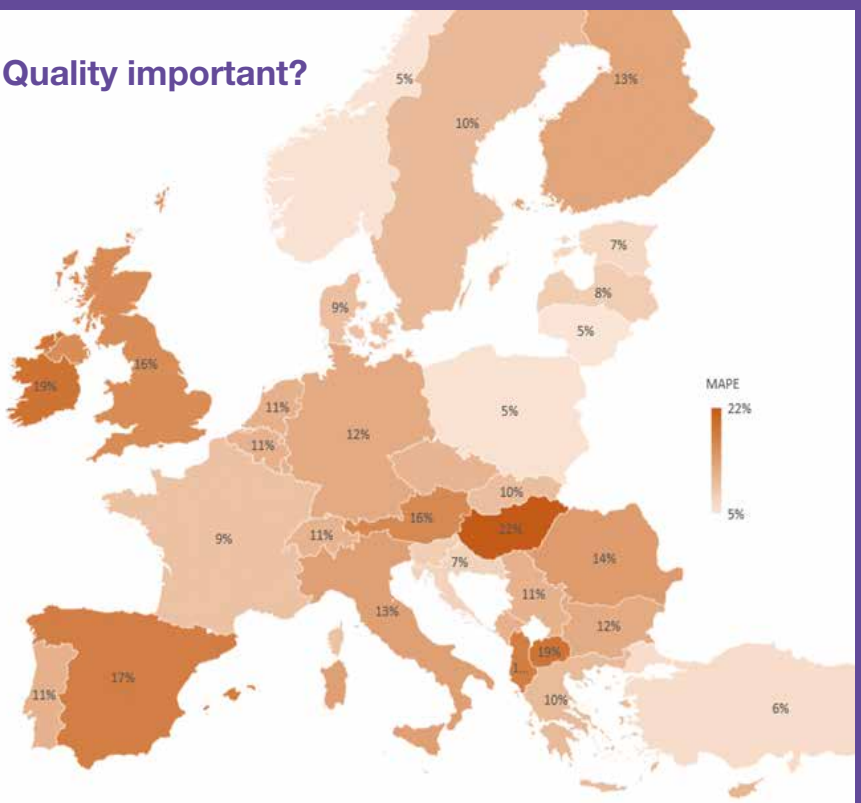


data were correct) were lower than actual delays in saturated European airspace. Further analysis generated more detailed results that showed airspace users in reality experienced an extra 12.5 million minutes of extra delay as a direct result of forecast biases. This is an increase of 157% and resulted in a cost increase of Eur678 million, or 200% rise. The average cost per minute also rose by 127% because of the deviation between forecasted and actual demand.

The large deviation between predicted traffic and actual traffic identified in the research has significant impact on saturated airspace. Already experiencing high demand, unplanned traffic places extra demand on limited resources and challenges the industry to look at ways to respond more flexibly to unpredictable events – whether peaks and troughs in traffic demand, unexpected weather or other natural events.

## Motivation: Why is Forecast Quality important?

- A recent study showed, that most of the STATFOR predictions on a 5-year time horizon are insufficient (see “The accuracy of forecasts“). Further, the confidence interval implied by STATFOR was not matched for the majority of observations (66% out of 305 observations).
- It is expected, that forecast quality has a significant influence on the operational performance of an ANSP. This performance might be expressed in CRSTMP delay or ATCO productivity.




*The figure shows the aggregated MAPE Score, which is a metric to measure forecast quality, for all available STATFOR predictions on a 5-year basis. A forecast with a MAPE < 10% is considered to be a good prediction, < 5% very good.*

Imprint

**Publisher:**
FAB Europe Central
www.fabec.eu

The purpose of this publication is to document the InterFAB Expert Talks by compiling the contributions provided. The content provided by the different authors does not represent the opinion of the publisher.

The publisher disclaims any responsibility for the content, images and graphics as well as any other materials contained in this work.

The work, including all contents, was compiled with the greatest care. However, the publisher does not guarantee the topicality, correctness, completeness and quality of the information provided. Printing errors and misinformation cannot be completely excluded. The publisher makes no warranties or representations of any kind concerning the accuracy or suitability of the information contained in this work for any purpose. The publisher does not assume any liability for the topicality, correctness and completeness of the contents of the book, nor for printing errors. No legal responsibility or liability in any form for incorrect information and the consequences thereof can be assumed by the publisher.



ISBN 978-3-9821488-2-3

**Picture credits:**
Source: DFS Deutsche Flugsicherung, DSNA, ENAV, Eurocontrol, European Commission