FLORENCE SCHOOL OF REGULATION

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POLICY BRIEF

EUROPEAN TRANSPORT REGULATION OBSERVER

Performance Review Commission: In search of flagships for Air Traffic Management Transformation

Highlights

The Performance Review Commission (PRC) is an independent body supported by EUROCONTROL with a remit to review and report on the performance of European air traffic management (ATM). While performance has improved over time, it has not always been consistent and shortcomings are expected to remain in the years to come. Future improvements will require a transformative change rather than just evolution.

With the aim of identifying, reviewing and championing successful transformation projects based on the ATM Master Plan and the European Green Deal, the PRC has produced a Transformation Support Strategy. This will enable analysis of the contribution of new technologies and concepts to the future performance of the ATM system. In this process, the PRC aims to identify flagship projects, monitor their performance over time, help stakeholders understand the challenges involved in implementing these innovative transformational projects and the resulting benefits, and thus stimulate and encourage improvements in ATM.

To engage key executive stakeholders in this process, in February 2023 the PRC hosted a workshop entitled 'In search of flagships for ATM transformation,' which sought to better understand the business-level benefits of delivering transformations and overcoming the challenges rather than focussing on operational and technical details. In particular, the workshop aimed to identify disruptive, innovative and scalable flagships which have the potential to make a substantial contribution to the performance of the ATM system in Europe over the coming years. This policy brief summarises the main takeaways from the workshop discussions.

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Issue 2023/06
April 2023

Flagging the right flagships

A comment by Matthias Finger, Florence School of Regulation – Transport Area

Increasing the performance of European ATM, in particular in terms of capacity and efficiency, is a long-standing objective that the aviation industry, Eurocontrol and the European Commission have been pursuing. It gained traction in 1999, when the Commission launched its Single European Sky initiative. But admittedly progress has been slow, to say the least, for many reasons, in particular institutional complexity and lack of alignment of the interests of stakeholders. And this is despite the fact that we have had SES I, SES II, SES II+, SESAR JU, the ATM Masterplan, the Airspace Architecture Study (AAS) and many other less systemic initiatives.

We have tried with plans, projects, rules, regulations, incentives … and a lot of money. We have also tried with huge investments in technological developments at various levels. A major boost came from the pervasive push of digitalisation, which materialised in the AAS. Today, we now know that technology alone will not make European ATM perform better, and neither will yet another set of ever more sophisticated rules and regulations alone. Technologies and rules will have to go hand in hand. But in such a complex system as European ATM, this is easier said than done. And where could the initiative come from, considering that all the stakeholders are parties to and, to a certain extent, also part of the problem?

A new outside pressure has recently emerged from climate change and the urgent need to decarbonize more or less everything. The pressure is particularly acute in aviation, the license to operate of which will depend upon its ability to demonstrate at least its goodwill. Admittedly, ATM is not at the core of aviation's decarbonisation efforts, but as the aviation system's infrastructure operator, it has a leadership role to play and even somewhat of an overall responsibility to deliver results already in the short run. Another 20+ years of ATM labouring with 'more of the same' will probably be fatal for the entire industry. In other words, the climate emergency may well be the ('last') push for ATM reform, an overarching objective that has the potential to drive and prioritise the various past and future performance initiatives.

The PRC has recently come forward with a quite novel yet very pragmatic approach to the matter. While SESAR JU is banking on research flagships that might have the potential to revolutionise ATM or at least increase its performance in the long run, the PRC is looking out for operational 'flagships in the making,' which can rapidly lead to concrete and measurable results. During the current Florence PRC workshop the following such flagships were identified: virtual centres, optimal routing, time- and distance-based separation, remote towers, airport operation centres and the Maastricht upper area control centre. However, identifying the most promising flagships is only a beginning.

As a next step, and in preparation for the next workshop later this year, it will be necessary to more precisely determine each flagship's impact on performance. Yet it will be even more interesting to identify the various factors that are preventing a flagship from delivering its full potential. And of course, one needs to be open to identifying still other potential flagships.

With this information at hand, another series of questions will have to asked, such as the following. What is a given flagship's potential to be scaled up, considering that all the flagships which have been identified so far still have limited geographical scope? What is the right number of flagships? That is, not too many so as to avoid scattering energy, but not too few to risk failure. How to be certain that the most promising flagships have been identified, namely the ones with the greatest contribution to overall ATM system performance improvements? The greatest contribution to which kind of performance exactly, as capacity and environment may not always go hand in hand? And then, once one is certain to have identified the right flagships, how to give them just the right level of nurturing? Not too much so that the flagship can continue

on its own, once enthusiasm and support have dwindled. Not too little so that the flagship gets lost in the overall noise of all the other initiatives.

All this requires collaboration among the stakeholders involved. It is therefore essential to identify interests and support for their implementation. Indeed, nurturing flagships is a matter of incentives, whereas all the PRC can offer is encouragement and visibility. Incentives can come in the form of money, but incentives will be more effective if they come in the form of performance gains. The most effective incentives typically come from the institutional conditions which encourage and reward the initiators. In addition, the incentives should be set in a way that favours system performance and not just yet another new gimmick or startup. Furthermore, incentives should be set in a way that all actors pull and/or push in the same direction. The Commission will inevitably have to play a key role here, as it has the power to set at least some of these incentives.

Therefore, the process initiated during this Florence-PRC workshop will have to continue to involve all the relevant actors, and maybe even new ones that were not yet around the table.

Performance Review Commission: In Search of Flagships to Transform Air Traffic Management

Main Takeaways from the Workshop Discussions by Teodora Serafimova, Florence School of Regulation – Transport Area

Introduction

The PRC sees transformation to be essential to realise future performance by deploying new and innovative technologies and introducing associated operational concepts and procedures. These will often require collaboration between multiple stakeholders, including air navigation service providers (ANSPs), airspace users and airports, and support from regulators and other parties. A key context for analysing performance and defining future requirements is EU policy on aviation and ATM

Modernising ATM is a long-standing EU policy objective. It is also a topic of direct relevance to the Single European Sky (SES) policy, the core objective of which is to improve air navigation services with a view to boosting performance to the benefit of both airspace users and the environment. In this context, encouraging the use of modern state-of-the-art technological solutions has been an integral part of the SES and in particular SES ATM research (SESAR) policies in the EU.

With the adoption of the European Green Deal, modernisation of ATM has also come to be seen as the licence for the aviation sector to continue operating in a decarbonised future. Indeed, while a number of different greening solutions will have to be implemented in parallel to reach net zero emissions by 2050, including market-based instruments, sustainable aviation fuels (SAFs) and disruptive zero-emission aircraft, ATM is expected to deliver the most immediate contribution to decarbonisation of the sector.

The Digital European Sky, a term that was coined by the Airspace Architecture Study (AAS) and is used in the context of the current ATM Master Plan, is widely recognised as the way forward to exploit the full potential of the available data. Increased levels of digitalisation will be crucial to deliver scalability and flexibility, which in turn are crucial preconditions for building a resilient and fit-for-the-future airspace system, as has been reaffirmed by the COVID-19 pandemic and the Ukraine war. To achieve this, effective real-time sharing of operational data between all the entities involved in the provision of air navigation services will be needed.

Over the past decade, the SESAR innovation cycle has served as a platform for discussion on research areas for flagships and promising technologies. The process brings together all the relevant stakeholders, including European institutions and Member States, to jointly decide on the development of new concepts and validate the subsequent deployment of them. Despite the somewhat comprehensive nature of the existing framework, there is broad agreement on the fact that its pace has been suboptimal. Although the tools to enable additional flexibility for air navigation service providers already exist, so far there have been a limited number of truly transformative projects in the national performance plans currently in force in the third reference period (RP3) of the SES. Resorting to the status quo, however, leaves the underlying structural issues unaddressed.

To deliver the required change in performance the focus needs to be shifted more to the deployment phase and the means to accelerate it. Regarding this, the workshop discussions underlined the importance of not only identifying promising flagships but also devising ways to effectively track and measure their performance so as to be able to encourage deployment of them and where appropriate set adequate incentives to spur their progress. In its SES 2+ proposal, the European Commission has sought to use the AAS and its underlying digitalisation concepts to create a legal framework that fosters transformation. However, it has clearly emerged that overcoming the challenges stemming from fragmentation will be a lengthy process and the incentives to drive transformation will have to

come from industry initiatives within the existing economic regulation rather than relying on the EU budget.

The PRC Transformation Support Strategy (TSS)

The Transformation Support Strategy was the underlying motivation behind the PRC workshop. Traditionally, performance monitoring has been a backwards-looking exercise assessing what has happened in the past. But to achieve future performance and the desired transformation of the ATM sector a change of approach may be necessary. This new approach should be more forward-looking and should identify what future performance should look like, what enablers of this performance are needed and what roadblocks are in its way.

Whereas evolutionary change is constantly taking place, revolutionary change in the form of disruptive transformation is much more difficult to achieve as it requires not only technology but also changes in mindsets, social dialogue, regulation and interaction between various partners, from ANSPs to airlines and airports. Many factors and actors need to work together coherently to deliver transformation. Against this backdrop, the PRC workshop sought to shed light on some successful transformation projects so as to draw lessons from them regarding how challenges have been overcome, the resources and processes necessary to deliver them and how they can be replicated more widely across the industry.

In the context of flagships, an important clarification was made in relation to the fact that flagships can exist at different stages of development, including research flagships, industrial flagships and deployment flagships. It is precisely when these flagships are implemented that one can assess performance and transformations. When looking at flagships, it is equally important that they are seen against the backdrop of existing well-defined plans and strategies such as the European ATM Master Plan and the European Green Deal.

Examples of flagships

Virtual Centres: Challenges in scaling up and delivery

The Skyguide Virtual Centre

The Skyguide virtual centre flagship in Switzerland has its origins in the fact that there were two area control centres (ACCs) in Geneva and Zurich, each with its own system and way of managing airspace: an arrangement which was not justified given the size of the airspace. While various options to combine them were explored, it was established that the most feasible and forward-looking approach would be to retain the two ACCs but have them operate as one. This solution was deemed particularly favourable because neither of the centres had to be closed yet full flexibility was guaranteed for them to operate location-independently. It is precisely these location-independent operations that are at the heart of the virtual centre concept and which represent an important paradigm shift. The concept should lead to more flexibility and scalability at a lower cost than operating from individual centres separately without the ability to support and take over each other's functions.

When first embarking on this journey back in 2014, Skyguide faced supply-related challenges as the necessary systems were either not available or were too costly. Consequently, Skyguide set out to build their own open system based on modern architecture. This had to be resilient and service-oriented. Phase one of the deployment of the virtual centre ran from 2014 to 2018. 60 million euros were invested, and 8 million euros a year were achieved in cost avoidance. Phase two, which ran from 2018 until 2022, saw the creation of a technological platform. Currently in the third and final phase, Skyguide is looking at the OPS concept, which is the biggest challenge involving a change from location-dependent operations to location-independent operations.

So what are the main lessons learnt from Skyguide's virtual centre experience? First, technological factors were not the main problem

since the technologies that were applied were not cutting-edge but instead proven service-oriented technologies that had been in existence for over 20 years. Instead, the main questions revolved around how to successfully deploy modern IT in ATM. Implementing the Swiss virtual centre entailed introducing modern technologies, new processes and new roles, and also re-skilling staff. Therefore, a step-by-step approach was adopted, given that despite being expensive it was deemed necessary to minimise risks. Moreover, the cyber security challenges Skyguide faced were highlighted as instrumental in helping to overcome a common reflex to use safety and labour considerations as an excuse to not move forward with change. The paradigm in aviation has been that change can compromise safety. However, looking at modern technology it can be said that not upgrading comes at the expense of safety.

Introducing new operating models, i.e. making the shift from location-based air traffic control (ATC) to location-independent ATM, was a challenging process. Corresponding process changes to shift 'from local to network' required new end-to-end business process thinking. The so-called 'dual soul' of ANSPs from a business model and operating model perspective was pointed out as another obstacle to change. In other words, while ANSPs are part of an international network and therefore have to cater to this network, they are also constrained by local mandates and national requirements.

The 'equipment mindset' and location-dependent thinking in the industry were underlined as characteristics only compatible with incremental changes and therefore they constituted another obstacle to disruptive transformations. This mindset transcends beyond the industry and is very much visible in both regulation and investment, which are also largely equipment- and asset-focused. Drawing on this, stakeholders urged for a paradigm shift away from equipment thinking (e.g. machines, assets) to service-oriented location-independent thinking (e.g. GPS).

In conclusion, stakeholders urged for more courage to embark on change and innovate, as opposed to waiting for regulation. The right incentives have to be put in place to recognise and support first movers pragmatically. Skyguide's virtual centre experience also underscored the need for real supplier competition by removing excessive barriers to entry for modern suppliers (e.g. certification and regulation in a small closed market).

The FINEST Virtual Centre

The FINEST virtual centre is another example that the workshop sought to learn lessons from. It is a first-of-its-kind attempt in Europe to combine the airspaces of two countries, Finland and Estonia, and is a poster child of a pan-European initiative called Single and Digital European Sky (SES) – a joint venture in the EU aimed at building a shared digital European airspace by 2025.

The concept foresees that in future, there shall be two ACCs in two locations, one in Finland and one in Estonia, which, however, will operate as one virtual centre able to provide services at any time and over the entire area of the two countries. While the system can work from either the ACC in Helsinki or the one in Tallinn, most of the time it uses a combination of the two with them supporting each other's capacity needs.

Performance targets have served as guiding principles in this project. Safety is one issue as the new system has to be at least as safe as, if not even safer than, the previous system. Capacity is another consideration as it is expected that the new system must be able to handle up to 20-30% more air traffic than the previous model but with the same amount of resources. Cost efficiency is another important consideration for airspace users. Last but not least, environmental considerations play an important role in motivating the project given that at present air traffic from Helsinki to central Europe is not able to make use of the most optimal trajectories or flight paths. The FINEST model aims to make more efficient use of airspace by building some parts of the sector on the Helsinki side and others on the Tallinn side.

Following three implementation phases, a single technical system with one airspace configuration has been established, a common set of procedures and working methods have been developed and identical licence and rating requirements have been introduced. The latter have been instrumental in enabling dynamic cross-border service provision from two locations and in enhancing cooperation. Open communication and trust were highlighted as key pre-conditions for delivering these results. Creating a common system has entailed sharing resources and undertaking joint procurement, which in turn have enabled considerable cost savings for both ANSPs and airspace users. Moreover, the FINEST project has led to better stakeholder management on both sides. When it comes to external benefits, a common system has enabled safer air traffic service (ATS) provision, more efficient and environmentally sustainable trajectories for airspace users, an overall increase in flight information region (FIR) capacity and more scalability and resilience.

Nevertheless, implementing the project has not been without obstacles. The project partners have not been able to go fully operational and complete the final fourth phase of the project, primarily due to sovereignty considerations concerning sharing military information, licensing and air traffic control officer (ATCO) liability. Drawing on this, participants highlighted the vital importance of close cooperation and backing by various actors in the eco-system, from governments and military bodies to national supervisory authorities (NSAs), civil aviation authorities (CAAs), employees and unions, and also the Network Manager.

Main Takeaways

The above virtual centre examples are two flagships of a somewhat local nature. However, the participants reminded us that the underlying objective of SESAR is to achieve a pan-European level of ATM modernisation. Drawing on this, they sought to identify the steps needed to achieve upscaling from the local and national levels to the pan-European level. While some argued that scale does indeed matter, with complexity significantly increasing as the scale goes up, others held that scale is not a determining factor but instead an excuse for inaction.

Going forward, some of the key challenges will be ensuring that flagship projects deliver the expected benefits to users and that these benefits can be properly demonstrated and quantified in performance plans. Participants also examined whether regulatory support is needed and how others can be encouraged to take similar initiatives. It was pointed out that scalability and flexibility do not have to wait for Europe-wide implementation and they can instead already be achieved in larger Member States with several ACCs, such as France and Germany for instance. In conclusion, the participants agreed that technology does not constitute the greatest barrier. Instead, coordination with relevant stakeholders and the operational dimensions are the most problematic. Participants focused on the need for enhanced cooperation between ANSPs and States, and mandates to exchange data.

The optimum trajectory: an idea for transformation

The concept of the ‘optimum trajectory’ is used to refer to a trajectory which minimises CO_2 emissions in the absence of restrictions (e.g. the route availability document, airspace closures). The ‘constrained optimum trajectory,’ on the other hand, is one in which CO_2 emissions are minimised while considering any existing airspace restrictions but excluding air navigation fees. Finally, the ‘achieved trajectory’ is the real trajectory that an aircraft actually flies. All these are expressed in terms of CO_2 emissions. The combination of the three concepts provides different KEO key performance indicators (KPIs), which can be used for different purposes. Since fuel costs account for roughly 35% to 40% of airlines’ total operating costs, it is not surprising that an optimal flight trajectory, and so minimising fuel burn and the related CO_2 emissions, is in the direct interest of airspace users.

The KEO optimal trajectory KPI flagship project in Spain, which involves a partnership between Vueling and ENAIRE, was motivated by a desire

to improve airspace efficiency, and in particular by the perceived incoherence of using two-dimensional indicators to measure the three-dimensional sector that aviation is. In discussions it was pointed out that the environmental KPIs, KEA and KEP, which are traditionally used to measure and abate aviation CO_2 emissions, are limited in that they do not take into account vertical efficiency, real fuel consumption (including planned winds) or the flight in its entirety. In view of this, the project partners were driven to define new methodologies capable of providing accurate information which would inform appropriate mitigation actions.

The solution proposed was to measure the optimal route in terms of real CO_2 emissions (KEO). This enables the measurement of emissions using real emissions over the entire flight trajectory. The data obtained are then used to implement airspace re-design measures based on weather patterns, for instance. The approach also enables both horizontal and vertical efficiency. The associated benefits are amplified if the approach is applied to flights over longer distances, although this would of course necessitate cooperation between more ANSPs and airlines. The finding shows that the great circle distance is not always the optimum trajectory when it comes to fuel consumption and environmental impacts such as CO_2 emissions.

The project was made possible thanks to close collaboration and trust established between an airline and the ANSP. This involved real-time sharing of CO_2 emissions between the two parties under a confidentiality agreement. Exchanging information between different stakeholders while maintaining confidentiality was one of the main barriers to overcome.

Main Takeaways

A first prerequisite for any target set on an indicator is having the necessary data available, which in turn is something that can potentially be facilitated by means of regulation. When it comes to the target-setting exercise itself, a longer-term perspective is necessary. Besides data availability, the need was stressed to clarify the purpose of measuring KPIs, the origin of the data, the entity in charge of defining the optimum trajectory and the criteria for doing this.

Going forward, the role of regulation in accelerating the introduction of the optimum trajectory concept was also explored. In monitoring performance the KPO indicator offers benefits in terms of allowing a clear picture of what would be the environmentally optimal trajectory. However, when it comes to target setting, participants stressed the importance of ensuring the accountability of air traffic controllers in relation to the optimum trajectory. Some pointed out that the KEO indicators fail to adequately address the accountability of different actors, which in turn may make it difficult to be tackled by means of regulations. Whereas the involvement of airlines in this was welcomed as an important step in the right direction, it was noted that other factors, such as civil-military cooperation, will also have to be considered. It was concluded that further reflection would be needed on the issue of accountability.

When it comes to upscaling this project, participants raised the question of whether it would be feasible for all flights to follow the optimum trajectory in view of capacity shortages. Since enlarging the scope of the project may lead to an additional workload for ANSPs, the role of tools such as automation may need to be examined in order to facilitate the exchange of information between the parties involved. A central precondition for success is for air traffic controllers to be equipped with the necessary tools to enable them to understand the optimum trajectory concept and then how to achieve it.

Application of the concept on a wider scale will also require discussion on airspace design, and in particular whether existing constraints are hindering optimisation. Drawing on the fact that military operations make a minor contribution to airspace inefficiencies, the need to eliminate strategic airspace restrictions stemming from civil aviation was mentioned (e.g. maintaining traffic for revenue purposes). Last but not least, a wider application of the concept will also be affected by the regulatory implications of the Fit

for 55 Package, which will see bills in the EU Emission Trading System (ETS) and taxation on airlines increasing in the future.

The systemic view and potential flagships

In the session on the 'systemic view,' the European ATM Master Plan was reiterated as the shared starting point for defining the vision and priorities for the future.

Research

Regarding potential research flagships, in the framework of the SESAR JU nine main areas are being examined with a view to delivering next-generation ATM transformations in the long-term perspective (2030 and beyond). Among these, three priority areas have been identified as deserving particular attention on the basis of the ATM Master Plan.

The first of these relates to achieving scalability and resilience by preparing the defragmentation of European skies through virtualisation and enabling a free flow of data across borders among trusted users. Some of the practical examples quoted were virtual centres, dynamic airspace configurations and remote towers. Green trajectories constitute the second priority area. The aim is to encourage early implementation of eco-friendly SESAR solutions beyond the current requirements of EU Regulation no. 2021/116, Common Project 1 (CP1). Practical examples include extended flight plan (eFPL) distribution to ATC, airline operational control (AOC) data increasing the accuracy of trajectory prediction and integrated runway sequencing for full traffic optimisation on single and multiple runway airports. The third priority area is cost efficiency to be achieved by following the communication, navigation and surveillance (CNS) rationalisation agenda. In discussions it was confirmed that a wealth of SESAR solutions already exist and they are sufficiently mature to enable voluntary implementation of them in the next reference period. A successful rollout of them will, however, require the creation of a stronger link between airspace, operations, technical evolution and changes in service delivery models.

Deployment

On the deployment side, CP1 was welcomed as a good basis for driving the transformation of ATM in Europe. The SESAR Deployment Manager (SDM) has translated the regulation into a concrete manual to guide operational stakeholders on the precise steps to take along with the timeline to follow, with a view to accelerating the digitalisation of European ATM towards greener aviation. The need was underlined for CP1 to be complemented with a synchronised approach between various bodies (research, deployment) and incentives to stimulate first movers.

Standardisation

Transitioning from R&D to industrialisation and deployment requires both regulation and standardisation. The need was underscored for a holistic and integrated approach in which R&D programmes and the needs defined within them are reflected in the work programme of the standardisation organisation.

While standards are a crucial tool to create a level playing field and facilitate the export of European leadership and expertise into the international arena, participants underlined that a delicate balance needs to be struck to ensure that the standardisation process takes place at the right time (i.e. not prematurely, but also not too late). Besides being timely, standards need to be relevant, of high quality and inclusive of all stakeholders. To this end, participants stressed the importance of a feedback loop from deployment back to the standardisation process so as to ensure that standards remain useful and relevant.

Ways to avoid rapidly outdated standards were also discussed in the workshop. One approach which the participants supported was to introduce performance-based standards which avoid prescribing specific manufactured products yet still open the door to the introduction of specifications by the industry that remove obstructions to interoperability in practice.

While it was recognised that failure to standardise might risk slowing down innovation, some stakeholders cautioned that implementation of all the standards might drive costs up excessively across the industry. Participants also acknowledged that tensions exist within the industry as, on the one hand, standards are seen as an essential tool for industry players to protect their own products and thus intentionally prevent interoperability, while, on the other hand, there is also a growing need for interoperability between systems. There is therefore a need for a strategic approach to standardisation. Remote towers and virtual centres were pointed out as two particularly promising flagships needing to be supported with a common taxonomy and standardisation.

Main Takeaways

One message that resonated among participants was that not all SESAR solutions should be mandated by means of regulation. To support this argument, the example of airports was used. They have followed a faster pace of innovation despite not having been subject to the same level of rigid regulation as is applied to ANSPs. For instance, the rollout of remote towers is not triggered by regulation but rather by the mere fact that they are cost-effective. While it was clearly recognised that regulation does not always act as an accelerator, participants were in agreement that where it is applied it should always be matched with the right incentives and sufficient financing.

From an aviation perspective, while more focus on capacity enhancement at the European network level is needed, many projects focus on local benefits. The performance and charging scheme has already included support for deployment, but questions were raised about whether investments are supported by these schemes and if the value for money is adequately realised. The question was also explored of whether incentives would be better utilised to stimulate non-early movers to move or early movers, who are often confronted with a negative business case due to lack of scale and pace. It was underlined that contracts should address both push and pull elements, with more attention to the latter. Last, besides regulations and incentives, participants examined the role of industrial policy in protecting and promoting the competitiveness of European industry and whether it should be better recognised as a driving force. To this end, priority policy objectives should be clearly defined and issues needing to be solved should be adequately identified (e.g. virtual centres and different industrial suppliers).

The transversal view and potential flagships

The High-Level Network Concept of Operation (CONOPS) 2029 provides a common high-level view of targeted European network operations by 2029. While the list of objectives is clearly defined, participants expressed concerns about their feasibility within the targeted timeline, considering today's pace of progress. Drawing on the fact that as many as 350 projects are managed by the SESAR Deployment Manager, participants agreed on the need to shift from the current 'scattered approach' to a more 'selective approach' which focuses on the flagship programmes with the highest potential with a view to achieving wide-scale deployment of them by 2029.

One of the proposals put forward during the discussion was to shift to programme management, with the focus on five main flagships: network management, en-route ATM, the terminal manoeuvring area/airport ATM, the military and delegation of airspace, and virtual centres. Implementation of real programme management, it was argued, would require designation of a programme manager for each programme. This person would be accountable for the progress achieved, would be supported by a team of experts covering all the necessary factors and would have a certain degree of neutrality. Successful programme management would furthermore require robust operational concepts, validation processes, agile feedback from operation stakeholders, bridging of the industrialisation gap, early preparation of safety cases and standards, and timely involvement of EASA and EUROCAE.

In order to manage the predicted traffic demand by 2029 and achieve improvements in major performance areas, a number of essential building blocks to be put in place were identified. These include full dynamicity of airspace organisation and utilisation; cross-border airspace structures and delegation of ATM provision where and when required; enhanced air-ground data exchanges; full implementation of Flight and Flow Information for a Collaborative Environment (FF-ICE/R1) services and initial integration of FF-ICE/R2 services; and continual trajectory synchronisation and information sharing from the planning horizon to the flight execution phase.

In a regulated industry like ATM, monopolies are not competing in or for the market, as they provide users with a public service. In view of this, participants discussed the need to create a conducive framework to foster a shift from 'flagships' to transformation. The incentives provided in the current performance scheme were criticised for failing to deliver the necessary change. The present incentives also lead to a so-called 'shopper attitude' in which not the best projects are selected but instead the ones that are most financially attractive. Participants explored the role of the regulatory framework in triggering transformation through various channels, including by 'prescribing' it (e.g. through the PCP/CP1 regulation or CD time-based operations) or by 'fostering' it (e.g. return on equity for investments, incentive schemes, cost-sharing mechanisms, benchmarking). Last but not least, the importance of ensuring the framework is linked to SES 2+ was also underlined, as there are political and legal frameworks that influence developments. Flagships were also highlighted as a tool to mobilise political will and trigger a mindset for change.

Decarbonisation was another issue tackled during this session on the transversal view. Once again, ATM was highlighted as having the most immediate role to play in cutting aviation sector emissions. In contrast to the decarbonisation agenda, which is marked by a sense of urgency and a conviction among all aviation stakeholders that failure to reach net zero emissions by mid-century will drive them out of business, the same cannot be said for ATM modernisation and the SES agenda. On the contrary, it was pointed out that poor ATM performance does not necessarily translate into being driven out of business. Despite ongoing efforts for over 15 years, there have been limited results. The lack of progress can also be attributed to political issues linked to rationalisation of the system and resistance at the local level against moving towards a greater degree of centralisation.

Achieving an ATM transformation requires all stakeholders to focus on the same objective, namely reducing fuel consumption and associated emissions. Acceleration of the deployment of ATM solutions will be key. Optimum trajectory-based flights and 4D trajectories were highlighted as the most promising flagships to exploit ATM's full potential for greening the sector. As was illustrated by the ENAIRE-Vueling experience, enhancing data exchanges and sharing additional data (e.g. on fuel) will be crucial. The need was stressed for full data-link implementation (i.e. digital air/ground communications between aircraft and ground systems), either as a condition or as a separate flagship. Last but not least, proper implementation of trajectory-based operations will entail costly changes in all operational procedures and re-training of ATCOs and pilots.

The operational/entrepreneurial view and potential flagships

From an operational perspective, the optimal trajectory concept was welcomed as having great value due to its potential to enable significant fuel cost savings and CO_2 emission reductions. The need was underscored for this flagship to start at the conceptual level rather than at the project level, with the main focus being on efficiency (in terms of environment, capacity and cost). Virtual centres, remote towers, ATM-portals, shared ATM systems and data-link implementation were also welcomed as flagships deserving particular attention by operational stakeholders. On the environmental front, contrail prediction and prevention was identified as a particularly

relevant area in the future, with further research needed on the magnitude of aviation's non-CO_2 impact, the prediction of ice super-saturation regions and observations with satellites and ground-based equipment. The workshop also identified en-route ATCO licensing, civil/military cooperation and planning based on the optimum trajectory, and ground optimisation as further ideas worth exploring. To facilitate progress, it was suggested that trade associations, like those that exist for European airlines and airports for instance, could play an important role as 'sounding boards' for discussing flagships.

Time- and Distance-Based Separation

The session on the operational/entrepreneurial view also provided an opportunity to look at concrete flagship implementation experiences. For instance, the UK National Air Traffic Services (NATS) replaced distance-based separation with time-based separation at Heathrow Airport back in 2015. The time- and distance-based separation concept was born from the SESAR vision to transform runway capacity in headwinds, which in turn were the greatest disruptors in Heathrow causing ca. 160-180,000 minutes of air traffic flow management (ATFM) delay a year, which is growing. Europe as a whole is indeed particularly constrained by Atlantic headwinds, which in the case of Heathrow compromise capacity by up to 20% a year causing delay and cancellations.

In view of this, project partners together with SESAR developed a tool which provides controllers with visual indicators that dynamically change according to the headwind at the altitude for the optimum time separation between aircraft types. The tool utilises downlinked Mode S data from aircraft and runway occupancy data from thousands of historical movements to calculate optimum spacing.

Swift implementation of this has been made possible thanks to the fact that both the problem and the corresponding solution were well defined. Furthermore, sufficient funding and support from SESAR JU were guaranteed and the implementation could be handled solely by the ANSP and the airlines without involving other parties.

Implementation of this rather small-scale operation brought considerable benefits for Heathrow Airport, which have manifested themselves in the form of improved spacing consistency, an over 62% reduction in arrival (ATFM) delays due to headwinds, more stability in landing and flow rates, and an average landing rate increase of 2-4.2 landings an hour, among other things. The overall savings accrued by Heathrow, including holding and delay, have amounted to ca. €40 million per year.

The project partners are now deploying pairwise time-based separation at Heathrow, which will further optimise and deploy precise aircraft type-specific spacing and markers equivalent to 2nm inter-arrival spacing where there is no wake vortex requirement. Toronto and Schiphol Airports have since replicated this model. There is a growing appetite globally among airports and ATC service providers keen to optimise the capacity of existing assets rather than building new runways.

Remote Towers

The implementation of a remote tower for London City Airport was another example that the workshop sought to draw lessons from. Remote ATC is a disruptive technology with proven potential to decouple service provision from the physical tower infrastructure at an airport. Remote towers allow ATS provision to grow in capacity based on traffic demand, given that additional remote equipment can be installed when needed. In contrast, conventional control towers are naturally bounded by their physical dimensions, thus they are inevitably oversized during the first years of operation and have limited growth possibilities afterwards.

Thanks to the fact that the implementation of the London City Airport remote tower could be handled by only the industrial partners, it was completed somewhat swiftly. Another factor which facilitated its deployment was the fact that the previous tower needed to be replaced in any case. No additional regulation was necessary for the project to be materialised, given that it stood to offer considerable benefits. These came in the form of enhanced safety (i.e. better ability

to detect risky situations thanks to better visualisation), cost savings (lower construction costs and subsequent economies of scale), scalability and better protection against cyber security threats. Moreover, the delinking of the control centre location from that of the aerodrome allows more convenient sites to be chosen (access, land cost). In sum, the workshop participants welcomed remote towers as a potential flagship to be further promoted going forward, given its flexible implementation model and applicability to many different types of airports.

Airport Operations Centres (APOCs)

Istanbul Airport's experience of introducing an APOC based on total airport collaborative decision-making (CDM) was another concrete example studied in the workshop. An APOC brings together the main airport stakeholders and is a platform for stakeholder communication and coordination based on shared knowledge. Instead of islands of potentially conflicting decision-making, the APOC provides coordinated capability supported by technology and processes, which balances the business priorities and strategies of the airport stakeholders. In this way, the APOC keeps the airport flowing by matching resources and facilities to changes in demand or schedules.

Besides digital transformation, implementation of the project has entailed a cultural transformation requiring different actors with different backgrounds, from airlines to ANSPs, to sit around the same table and collaborate. An APOC also requires close cooperation with the Network Manager. Efficient data management and exchange are essential in facilitating this enhanced collaboration. Notwithstanding the lengthy process to bring it to fruition, Istanbul Airport's APOC has delivered numerous benefits in the form of fewer delays, better predictability, more capacity and reduced costs, among others.

The Maastricht Upper Area Control Centre (MUAC)

MUAC is the first centre in Europe operating in a large airspace of four States. Bringing it to life entailed development of common ATM systems for the four ANSPs and the military, shared infrastructure and applications, and converging operational concepts. The workshop participants agreed that MUAC in itself could be considered a flagship project as it is an illustrative example of cross-border cooperation. This cross-border cooperation was not only technical in nature but it also came with the need to overcome cultural differences. Its implementation underscores the importance of strong regulatory support and oversight, together with investment in automation. Of particular note is the ATM Portal, which has the potential to be a flagship project, and also the Shared ATM Systems, which represent a form of Virtual Centre and are worth further exploration. The project on contrails is also of interest and has a strong connection with the work on optimum flight. In order to mitigate the risks associated with depending on a single industrial supplier, MUAC has opted for in-house development. This approach has effectively facilitated cooperation with ATCOs, but it has also come with substantial costs.

Conclusions

The workshop revealed a broad consensus on the need to change the way ATM services are provided, the way operations are organised and the way data is shared. There also appears to be a shared understanding of what needs to be achieved in terms of transforming the ATM sector. In particular, it was confirmed that the AAS remains extremely relevant in the current context, and its ideas need to be put into operation. However, divergences remain regarding various stakeholder priorities and understandings of how to reach the ultimate objective.

The workshop discussions led some to question whether the term 'flagship' remains appropriate in the context of pursuing ATM transformation given that its use has been applied in different contexts to cover policy-orientation flagships,

research flagships and problem-solving flagships. Going forward, participants agreed on the need to narrow down the list to a reasonable number of flagships.

Virtualisation and location-independent operations, the optimal trajectory and airport integration with a network approach were identified as the most strategic flagships deserving further work and replication on a wider scale. Although they are very different concepts, what they all have in common is a fundamental role of data and data sharing. An enabling factor behind the success of the projects presented was the ability of different stakeholders to come together to recognise a common challenge and to agree on a common solution. The involvement of different partners is indeed a factor determining success, and it needs to be accompanied by the right incentives, indicators, trust and cross-border cooperation.

Whereas most of the projects remain limited in their geographical scale (i.e. one airport, one country or at most two countries), the ultimate aim is to achieve an impact of the flagships at the network level in Europe. Achieving this network-level impact, however, entails involving a significantly larger number of stakeholders, which brings higher costs and complexity. Going forward, upscaling the flagships would necessitate encouraging ANSPs and other actors in the aviation value chain to go beyond what is mandated by regulation to take risks and experiment with more advanced approaches. This type of behaviour to 'lead by example' is to be encouraged by means of adequate incentives and indicators. The main challenge will be to set the incentives so as to ensure that the entire system performs.

Naturally, cultural differences exist both between various stakeholders and within organisations, where, for instance, technical and construction divisions do not always successfully cooperate with operational divisions. Change management will therefore be crucial to achieve results. Given the still limited sense of urgency for change in ATM, in particular when compared to the decarbonisation agenda, the need was underscored for political support by Member States and policy direction by European institutions.

In sum, the key role of regulation was reiterated as a driver of transformation while it was underlined that much more can be achieved today with the existing regulation (performance and charging schemes) than is commonly believed. For instance, in July 2021 the European Commission took Greece, Malta and Latvia to court for failing to implement a data link, which in turn sends a signal that regulation has to be accounted for. Moreover, the time scale was identified as an important element to consider when assessing the impact of performance and success of flagships. Most projects require a longer-term strategy. Besides performance monitoring, more attention will have to be paid to the factors enabling success and the main hurdles in the way of reaping performance benefits.

Flagships identified during the PRC workshop

- Virtual centres
- Optimal routing
- Time- and distance-based separation
- Remote towers
- Airport Operation Centres (APOC)
- ATM Portals

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The FSR-Transport Area's main activities are the European Transport Regulation Forums, which address policy and regulatory topics in different transport sectors. They bring relevant stakeholders together to analyse and reflect upon the latest developments and important regulatory issues in the European transport sector. These Forums inspire the comments gathered in this European Transport Regulation Observer. Complete information on our activities can be found online at: fsr.eui.eu

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Published by
European University Institute (EUI)
Via dei Roccettini 9, I-50014
San Domenico di Fiesole (FI)
Italy

Co-funded by the
Erasmus+ Programme
of the European Union

doi:10.2870/08215
ISBN:978-92-9466-364-1
ISSN:2467-4540
QM-AX-23-006-EN-N