

POLICY BRIEF

EUROPEAN TRANSPORT REGULATION OBSERVER

ATM transformation flagships – continuing the journey

Highlights

The Performance Review Commission (PRC) is an independent body supported by EUROCONTROL with a remit to review and report on European air traffic management (ATM) performance. While performance has improved over time, this has not always been consistent and the PRC believes that future improvements will require transformation rather than just evolution.

With the aim of identifying, reviewing and championing successful transformation projects based on the ATM masterplan and the European Green Deal, the PRC produced a Transformation Support Strategy in 2022. This enabled assessment of the contribution of new technologies and concepts to the future performance of the ATM system. During the process, the PRC aims to identify so-called flagship projects, monitor their performance over time, help stakeholders understand the challenges involved in implementing them and in doing so stimulate and encourage improvements in ATM.

In order to involve key stakeholders in this process, in February 2023 the PRC, together with the Florence School of Regulation Transport Area, hosted a first workshop entitled '*In search of flagships for ATM*

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transformation.' In this workshop a series of disruptive, innovative and potentially scalable flagships were identified pertaining to virtual centres, optimal routing, time- and distance-based separation, remote towers and airport operation centres.

Furthering and strengthening this process, the PRC, again together with the Florence School of Regulation Transport Area, hosted another workshop entitled '*In search of flagships for ATM transformation: continuing the journey,*' which took place in Brussels on 21 November 2023. This second workshop aimed to determine more precisely the impact of each flagship on performance, pinpoint the factors preventing flagships from delivering their full results and identify new possible flagships. We summarise here the main takeaways from the second workshop.

Towards a more systemic and more institutional approach to flagships

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

Having been a co-organiser and a moderator of the PRC's initiative on ATM flagships and having followed the bumpy evolution of Single European Sky (SES) since its inception, I would like to offer some personal 'end-of-career remarks' on flagships in general and on the flagships presented during this workshop in particular.

For a start and considering the stalemate which SES has manoeuvred itself into during its almost 25 years of existence, identifying flagships as the PRC does constitutes, in my opinion, a welcome alternative and much needed sign of hope. What is particularly encouraging is the bottom-up approach, which contrasts with the prevailing top-down practices. Indeed, this bottom-up approach reveals many interesting projects and practices, most of them being developed at the 'edges,' be they the edges of Europe, the edges of the existing institutional boundaries or the edges of ATM. This is actually not astonishing and perfectly fits the theory of innovation. It is indeed not in the silos and stacks where innovation happens first, but at the interfaces and the margins.

However, there are also limits to this bottom-up approach. As became clear during the workshop, all these flagships are up against a by now heavily institutionalised technical and economic regulatory framework which prevents them from flourishing, not to mention from scaling up. The workshop also highlighted, albeit more timidly, that these innovative flagship projects are up against vested interests, which in itself is nothing astonishing and again in line with the theory of institutional change. But then typically the usual suspects get mentioned, such as ATCOs and politicians. What is not mentioned sufficiently, in my opinion, is the ATM industry, which likes to pride itself on being the champion of innovation but which also has its vested interests, generally in maintenance of the status quo. In this context it was quite sobering to observe that, when asked, the industry had not much to propose in terms of innovative and disruptive projects that

are being deployed now and that are ready to qualify as flagships.

There were widespread complaints during the workshop about regulations preventing innovation, a complaint that is of course valid and not astonishing either given that regulation generally lags behind technological developments. But what is often forgotten is the fact that the regulations in place have not been invented by extraterrestrials but in fact reflect institutionalisation of and compromise among various stakeholders' (vested) interests. As a result of 25 years of rule development, no single actor, not even the Commission, is any longer powerful enough to reform the current ATM institutional framework, yet every major stakeholder is still powerful enough to obstruct much-needed changes. In other words, we are in institutional gridlock: there are too many cooks in the kitchen, each of them of course a chef.

In the light of this admittedly personal observation, I am not convinced that purely operational flagships, no matter how innovative and disruptive, will be able to bring about much-needed changes. Insisting on the fact that flagships must rapidly result in quantifiable operational performance outcomes carries the risk of leaving out precisely the really transformative flagships of a systemic nature, which are, however, the kind of flagships that we will ultimately need. I was struck by the fact that virtual centres, digital and remote towers and even the Istanbul APOC ended up seeing their flagships as part of a larger mainly digital transformation process, sometimes considering a too narrow approach to be an impediment to their flagship's success and overall contribution to performance. What if most of the flagships identified were only different facets, small pieces of the puzzle of the same digital transformation the entire aviation industry is going through? And how will these pieces ever be put in place without a political and regulatory environment that supports them?

Main Takeaways from the discussions

Introduction

There will be growing competition for the right to pollute. Against the background of the EU's aspiration to decarbonise transport, the difficulty in decarbonising aviation in particular and the ensuing pressures for multi-modality and modal shift towards less carbon-intensive transport modes, it became clear that the aviation industry overall must become more cooperative and start considering itself to be a player in the larger transport value chain. Instead of optimising itself alone, ATM stakeholders must become team players contributing more actively to the performance not only of the broad aviation system but also to that of transport overall. Partnership differs from friendship in that partners work together so that every partner gets a fair slice of the cake. Without cooperation, there may well be no cake at all.

Aviation as a single networked system. Even though everyone is working on specific projects, such as the ones discussed in this workshop, one must not forget that the ultimate aim is to improve the performance of the overall networked aviation system, which includes not only all the ANSPs but also the airlines and airports. While 'disruptive network evolution' is the aim, the various innovations promoted by the different projects should not endanger the system or optimise parts of it to the detriment of others or the overall system at large. This calls for an overall network strategy plan capable of orchestrating (e.g. appropriately timing the different projects), integrating (e.g. by paying particular attention to interoperability) and accommodating (e.g. with open architecture) all the various innovations taking place. Even though this strategy is currently proposed by the Network Manager, it is a network strategy not a network manager strategy. In addition, one should not forget that innovation in ATM, no matter how disruptive and technologically attractive, should ultimately serve users and society at large in the areas of capacity, safety, performance and sustainability.

Defining the PRC's role in this process. Traditionally, the PRC has been looking backwards, assessing what has happened in the past. However, given

the new challenges that come with the ATM masterplan and the Green Deal, the PRC's role also has to evolve and become more forward-looking. On the basis of its transformation support strategy, the PRC aims to identify flagship projects that deliver substantive environmental and capacity performance improvements, monitor their performance over time, help stakeholders understand the challenges involved in implementing them and the resulting benefits, and thus stimulate and encourage improvements in ATM. The PRC therefore focuses on the deployment of projects rather than on research activities, i.e. on projects that deliver performance results, which are already in place and which can potentially be shared across the industry. During its first workshop in February 2023, such flagship projects were identified in the areas of optimum trajectory, virtual centres, digital and remote towers, airport operation centres and time-based separation. The advances in each of these projects were assessed during this second workshop.

An optimum trajectory and beyond

An optimum trajectory project was presented during the first PRC workshop as a response to the fact that current ATM key performance indicators (KPIs) are limited when it comes to measuring CO₂ emissions. This is because they do not capture vertical efficiency, real fuel consumption or the flight in its entirety. The solution proposed was to redesign flight trajectories based on real emission data, so-called 'fuel-trajectories.' This requires cooperation and trust between ANSPs and airlines as it involves real-time sharing of sensitive information, such as for example fuel data, while maintaining confidentiality. This flagship project is in its initial stage and was not presented in detail, but the PRC reported that it had set up a working group with airlines and ANSPs to establish a data-analytical framework for the validation and sharing of data.

During this second workshop it was furthermore highlighted that non-CO₂-related climate effects, namely contrails (but also air quality and noise), equally need to be taken into account when it comes to designing and flying 'optimum' trajectories. It was mentioned that DG Clima is already working on a comprehensive measurement and verification process in which starting in 2025 airlines will have to

report both CO₂ and non-CO₂ emissions. There is also a trade-off between fuel efficiency on the one hand and contrails on the other, as the more fuel efficient an engine is (thus the fewer CO₂ emissions), the more contrails it generates. This is likely to complicate the optimum trajectory discussion, which in turn explains the lack of maturity of flagships in this area.

Virtual centres

In the area of virtual centres, three different flagship projects were presented at the workshop, starting with Skyguide. To recall, Skyguide's initial problem stemmed from operating two independent Area Control Centres (ACCs) in a small country such as Switzerland, something that could not be justified on economic grounds. For political reasons it was, however, not possible to merge these two centres and it was therefore decided to create a single virtual centre by changing to a location-independent approach.

The following three main challenges were identified during the implementation of Skyguide's virtual centre, a process which is still ongoing. The first challenge pertains to costs and financing: the fact that Skyguide had to finance its virtual centre solely from its operations forced a technical reprioritisation because the money earmarked for innovation was no longer spent on improving legacy systems, which negatively affected operations. This consequently led to the most difficult challenge: to simultaneously maintain reliable operations while evolving towards a virtual centre, a process which was compared to "open-heart surgery while running." This transformation process inevitably came with an operational impact.

The third challenge pertains to regulation, namely the changing regulation which does not enable innovation and the recent ATM ground equipment regulation, which increases compliance costs for small solution providers such as Skyguide. Indeed, regulation still very much follows an airworthiness approach, whereas an open architecture approach would now be needed.

The second flagship project in the area of virtual centres is that by FinEst. It constitutes the first European attempt to integrate airspaces in two differ-

ent countries: Finland and Estonia. As was presented at the first workshop, the purpose of FinEst is to keep both ACCs, with each of them being capable of providing and supporting the services of the other. FinEst should lead to an overall increase in capacity, more efficient trajectories, significant cost saving and resilience. However, progress towards realising FinEst is hampered mainly by issues pertaining to national sovereignty, more specifically military information exchange. In other words, the main impediments are neither technological nor operational nor legal per se. Instead, they stem from a lack of political will.

The Maastricht-Karlsruhe Network (MaKaN) is a flagship presented for the first time at this workshop. It results from cooperation between MUAC and DFS and it aims to create a shared ATM system hosted on data centre technologies using existing system and software components for an upper airspace control centre for an airspace that belongs to four different nation states. This future common system will run on two geo-redundant data centres, thus ensuring business continuity. The challenges encountered are related to finding a common technology for deployment, aspects of the transition from classical monolithic systems to virtual machine-based software applications and addressing differences in operational concepts in the two upper area control centres. Additionally, difficulty in securing regulatory support for the 'transition technology' from the respective regulatory authorities could pose future risks for the collaboration.

In conclusion, it can be said that the virtualisation of ATM does and will depend on (1) a carefully carried out transformation process combining business continuity with innovation, (2) incentives to invest in the necessary technologies and associated novel concepts of operations, (3) appropriate regulations to support the transformation process (e.g. licensing), and (4) the political will of the member states involved. Overall, it was said to be vital that all relevant stakeholders – from ANSPs to National Supervisory Authorities (NSAs) to Civil Aviation Authorities (CAAs) to performance standard setters and regulators to the network manager – must collaborate towards reaching the same goal.

Digital and remote towers

Two flagship projects were presented in the area of digital and remote towers, the first one having been followed since the first workshop. NATS London City remote tower operations began in January 2021 with the ATC service delivered from 115km away. Overall, the operations are said to perform well with the usual small hiccups that early adopters encounter. However, the main lesson learned from this flagship project pertains to the fact that there are many other, sometimes intangible, benefits that come with the digital transformation of tower operations, such as increased safety and resilience. A too narrow approach to remote towers by both tower operators and investors brings a risk of not factoring in these larger benefits. Nevertheless, it is obvious that remote towers can offer a lower cost and a higher performance alternative to building a new tower or replacing a conventional one.

The second flagship project in the area of remote and digital towers is by Avinor, which simultaneously operates airports and air navigation services. The remote tower centre in Bodø, Norway, currently operates services at 11 airports. Overall, implementing remote and digital towers is said to be challenging, with the main challenges pertaining to the integration of military and civil operations and scaling up (simultaneous operations in up to three airports from one remote position). The critical success factors and impediments to implementation are said to relate to management support, 'change management' (given the significant size of the staff and the other stakeholders involved) but most importantly to changing the rules and regulations, which do not allow non-geographical system certification. What would be needed is a system licence with geographical specifications, not a geographical licence with system specifications. In addition, ATCO licensing should evolve accordingly.

In conclusion, it has become clear that remote towers are basically digital towers and as such they are part of the larger digital transformation of airport tower operations, from which ultimately there is a bigger gain (e.g. digitally augmented operations, full performance contingency facilities, release of high-value real estate at airfields/airports, low visibility operation improvements, enhanced operational capabilities, multi-tower service centre possibili-

ties and many more things). It would be wrong to think that the technology would only work for certain type of airports. Scaling up the above two flagship projects will of course need some adaptation and implementation of additional features, but there is no real limitation stemming from the size of the airport. Finally, the importance of delivering not only digital towers but a digital value chain which is part of airport management was also highlighted during the discussions on these two flagships. This larger perspective is necessary if we want to improve the performance of the overall network.

Airport operations centre

An airport operations centre (APOC) flagship that was already presented at the first workshop is Istanbul's new airport (IST). An APOC brings the main airport stakeholders together to build and operate a platform for 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 all airport stakeholders. Implementing an APOC is a stepwise process from airport collaborative decision-making (A-CDM, which only increases predictability during the day it operates, covering aircraft milestones and introducing target times for off-block, start-up and the pre-departure sequence) to the airport operations plan (AOP, which integrates airside and land-side management and serves as a single source of information and operational facts at the airport, and is available to all stakeholders). The actual implementation of an APOC may differ according to local conditions and working relationships. A 'joint' physical location can provide a working environment with representatives of all stakeholders and it may facilitate a change of the existing culture into a culture of faster collaboration compared to only system-based collaboration and data sharing. As a next step, IST is moving towards total airport management (TAM), which involves connecting all types of information in the APOC collaborative area (physical place), so decisions can be made based on actual facts regarding ongoing operations. TAM goes beyond the AOP by covering other airport factors that are under airport management (e.g. passengers, customs, baggage, city connectivity, mul-

timodality and environmental management through noise and emission indicators).

During the ensuing discussion it became clear that such a structured and systematic approach to implementing an APOC as in the case of IST was made possible thanks to two success factors, namely the greenfield approach and the fact that IST is managed from an investor's perspective, thus creating a unique focus on customers and added value. Nevertheless, the overall long-term aim is to have Istanbul airport's APOC contribute to increased performance of the pan-European network, as a typical 1-minute ground delay at a European airport is said to lead to a 1.5-minute delay in the network. In other words, the better IST performs the better for the network, and the better the network performs the better for Istanbul Airport.

Finally, the issue of sustainability in an APOC was also raised during the discussion. Despite the need to control emissions and various initiatives to improve environmental performance, one should not underestimate the importance of waste and utility management. In fact, well-designed waste management programmes can lead to relevant utility savings.

Time-based separation

The time-based separation (TBS) concept was originally proposed in SESAR's ATM masterplan with the aim of transforming runway capacity when there is a headwind by moving from distance-based to time-based separation. According to many stakeholders, at London Heathrow TBS is the "biggest game-changer in airport ATC operations in recent times." Since it was deployed at Heathrow in 2015, the system has demonstrated its diverse benefits, not only in terms of capacity gains but also, and more importantly, in terms of improved resilience, confidence, safety and environmental management. Overall, the benefits far outweigh the original investment.

The TBS flagship project presented at the second workshop was the case of Amsterdam airport as implemented by LVNL, which is based on the system (developed by NATS) which is already operational at Heathrow. Again, the benefits of TBS were immediate and it led specifically to significant-

ly higher throughput levels when there are strong headwind conditions, more heavy traffic in the traffic mix (capacity benefits) and a positive effect on the necessity to use an additional landing runway (noise benefits). In addition, TBS is easily scalable and does not require many changes to airport infrastructure, only some modifications and interfaces added to the existing systems. TBS is also not limited to capacity constrained airports. However, it does require the airport and the ANSP to be willing to change. Another requirement for TBS to succeed is a strong partnership between suppliers and operators. Finally, being such a 'no brainer,' participants wondered why TBS was not more widely deployed already.

New potential flagships

The second part of the workshop was dedicated to identifying new potential flagships that can enter the PRC's flagship monitoring process. To this effect, the main industry players (in no particular order) were asked to present what they thought could qualify as potential flagships to ultimately transform ATM and its performance.

The presentations included a range of projects, both local initiatives and larger scale solutions at different stages of development from early ideas to (nearly) deployed systems. The PRC will review each of these for potential progression as flagships now or in the future when they are further developed.

- ADB Safegate proposed two concrete flagships, namely on remote marshalling operations and on remote pushback operations. The first project started in the context of a high number of flights arriving at occupied stands. As part of this project marshalling management was centralised and decision-making supported by technology. This led to more precise operations and improved conflict resolution, allowing also for weather independence. The second project, remote pushback operations, was developed in the context of complex pushback procedures leading to inefficient decision-making. The project involves automated tower remote-controlled pushback operations, the active involvement of pushback vehicle manufacturers and decision-making support. Its main benefits are a

reduction in the workload and complexity for ATCOs, a reduction in resource dependencies, offloading of radio communication and improved (prescriptive) conflict resolution.

- MUAC proposed an ATM portal (ATM-P), which is a platform aimed at optimising delays of priority and critical flights. The platform gives all its users the possibility of collaborating, sharing data and information, and benefiting from a range of cost-saving and environmental efficiency opportunities. The platform optimises selected delayed flights by means of a priority and critical flight watch, slot time assistance and route optimisation for the MUAC airspace. The tool is furthermore easy to use, transparent to all actors and its performance benefits are measurable (delay and related cost and track shortages, and fuel and emissions).
- Frequentis proposed the concept of a digital connectivity framework open to all, which would enable data sharing, higher levels of automation, integration of AI and current and future datalink technologies, together with new applications.
- Indra is currently developing both the technology and the architecture so as to operationalise SESAR's ATM masterplan in Canada.
- Leonardo presented a transformation of its own organisation characterised by digitalisation and aimed, among other things, at sustainability.
- Saab presented its own digital tower solutions and in doing so underlined the relevance to the remote and digital tower flagships that had already been identified by the PRC.
- Thales offered a concept similar to that of Frequentis, namely an open, safe and secure digital ATM platform, stressing in particular the importance of standardised APIs.

Frequentis, Indra, Thales and Leonardo all presented ongoing work revolving around employing the benefits of architectural and technological developments: service-oriented architecture, higher levels of interconnectivity of functions and services, digital platforms and virtualisation. The workshop participants concurred that there is future work required to better understand the scope of these capabili-

ties and their expected benefits and progress towards deployment, which will allow assessment of the suitability of these projects as potential flagship candidates.

Conclusions

A substantial part of the session was devoted to a more conceptual discussion on the nature and role of flagship projects. On the one hand there are projects that are more system-oriented, such as connectivity and sustainability, whereas on the other hand there are flagships that tend to be more locally oriented such as digital towers and remote marshalling. The PRC stressed that both system and locally oriented projects are pivotal in order to improve ATM performance. However, the performance of system projects seems to be harder to measure and monitor, which means that they cannot yet be strictly considered flagships in the sense that the PRC defines them. This shows the importance the PRC gives to measurability. The main reason behind this measurability requirement stems from the PRC's observation that huge investments in ATM research in recent years have resulted in few concrete results. This is why the PRC is deliberately looking for concrete projects with measurable performance results.

One of the observations made during the workshop labelled some flagships "local initiatives." However, as part of the ATM masterplan these flagships (e.g. TBS) are key parts of the network solution and contribute to network performance improvements, especially as more widespread deployment delivers a cumulative benefit stemming from the 'whole is more than the sum of its parts effect.'

Furthermore, the following four questions raised by a participant triggered a substantive discussion about the real obstacles preventing disruptive projects from happening:

- Why are European capacity constrained airports not implementing TBS when this is a 'no brainer'?
- Why are European airports building new towers when we know that remote/digital towers could now replace them?

- Why are stakeholders complaining about regulation but failing to point out which specific regulations should be modified or abandoned?
- Why are many innovative projects from industry being developed in Canada, Brazil, China, etc. rather than in Europe?

Consequently, it was possible to dig a little bit deeper and specifically highlight the lack of alignment between technical regulations on the one hand and the objectives of the ATM masterplan on the other. It was stated that the industry's long term goals and challenges are well defined in the ATM masterplan but not reflected in the technical regulation. While some participants considered that a flexible interpretation of the current regulation allowed innovative behaviour, the workshop revealed a broad consensus on the need to change the regulatory framework. Some participants expressed their frustration when talking about their experiences of trying to be innovative and compliant at the same time. Being compliant and innovative is possible, it was said, but has a real cost. Concretely, it means that the innovator has to bear the burden of proof, especially with regard to safety, which in turn adds extra costs to already limited funding resources.

The workshop concluded with a broader discussion on the need and urgency for all industry stakeholders to collaborate, thus echoing the introductory remarks about the growing pressure on the aviation industry as a whole resulting from today's climate urgency. Indeed, the need to create a truly collaborative environment was a widely shared idea among all the participants. The first outcome of such a more collaborative attitude, it was said, should result in a common agreement on the most relevant problems to act on in order to improve ATM performance.

FSR Transport

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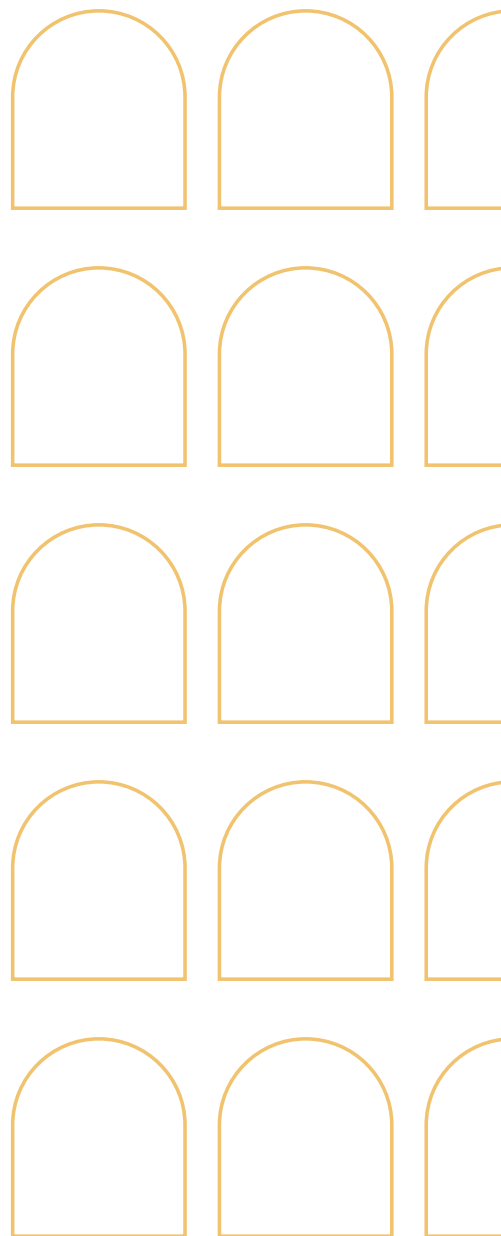
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