

ATC Mobility and Capacity Shortfalls

For the first eleven months of 2022, ATCO shortages and subsequent lack of capacity have amounted to 7.43 million minutes of en-route ATFM delay (for 8.56 million flights). These delays are not evenly spread across the European ANSPs, but rather are concentrated in a few areas that regularly are not been able to meet capacity demands during peak periods. Europe is clearly not ready to meet the traffic levels of 2019 (expected to be reached in 2025), let alone the 44% increase in traffic forecast for 2050¹ (1.2% average annual growth from 2019).

CAN ATCO MOBILITY BE PART OF THE SOLUTION?

ATCO Mobility

Historically, this term **has had a strong geographic association**, meaning that mobility implied a physical relocation of an ATCO from one Area Control Centre (ACC) or ATS unit to another, or less frequently, one State to another.

Another form of ATCO mobility is **remote or cross-border operations**, where ATCOs do not physically move but rather control airspace outside that normally controlled by their ACC – potentially in another State.

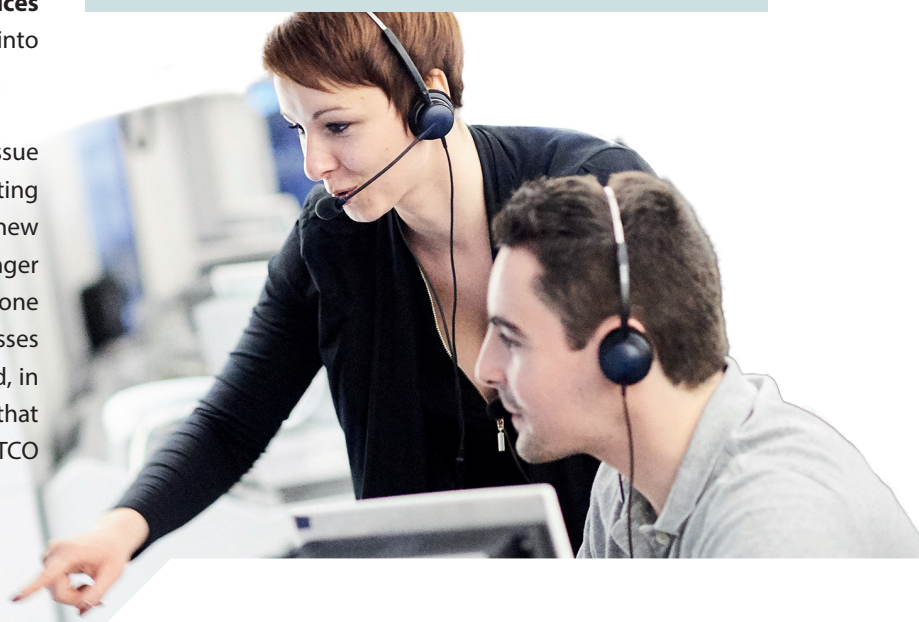
In this case, qualified ATCOs may be assigned to the airspaces and sectors where the demand is greatest, irrespective of national boundaries, with potentially attractive gains in terms of flexibility and scalability. However, a significant challenge to this approach is the willingness of States to **enter into agreements that enable the delegation of Air Traffic Services (ATS) in their sovereign airspace**, taking into account national security issues.

For both types of ATCO mobility, a significant issue is the time taken to 'convert' (i.e. obtain a new rating endorsement) from one sector group to a new sector group. This is usually considerably longer than the time taken for a pilot to convert from one aircraft type to another. This Think Paper addresses why ATCO conversion training is challenging and, in complex airspaces, takes so long. It looks at ways that may meaningfully address the challenges of ATCO training.

¹ EUROCONTROL Aviation Outlook 2050 Report. April 2022.

KEY CONCLUSIONS

1. ATC capacity/staff shortages are a major cause of delays in Europe, costing over €800 million this year. As traffic recovers and grows, this is likely to continue.
2. ATCO mobility could help. This can either be through ATCOs moving within/between ANSPs – or by an ANSP providing a service outside its borders
3. Technical and regulatory enablers already exist to support ATCO mobility solutions but there are obstacles, such as sovereignty and national security issues.
4. The European ATC Licence, with a common rating system and rules to mandate mutual recognition, is already in place. However, national requirements relating to language, education and citizenship make it difficult for ATCOs to move between countries.
5. While a common syllabus has been established for initial training, there is a need to harmonise operational training.
6. The time taken to convert ATCOs to new airspace should be minimised, while maintaining safety, so as to encourage mobility. The example of the conversion of pilots to new types is relevant.
7. A common standard target throughput per ATCO per sector, allowing for airspace complexity, ATM system capability and traffic profiles, should be agreed for Europe.
8. ATCO fatigue rules affect the number of available ATCOs; these rules need to be harmonised in order to achieve a level playing field among European ANSPs.



Other Factors

Both forms of ATCO mobility may be able to reduce delays caused by a lack of capacity/staffing. However, they can only form part of the solution. Ab-initio training of more, new ATCOs in the affected ANSPs is clearly required and there are other factors that influence or make a significant contribution to the imbalance in airspace demand vs capacity. These include:

- over-attractiveness of particular routes/airspaces due to lower en-route charges
- co-ordinated re-routing solutions impacting on revenue
- ANSP cost implications for staffing levels that meet peak demand periods but create over-staffing levels for low traffic periods

The above factors notwithstanding, this Think Paper considers how and if the notion of ATCO mobility can contribute to relieving the capacity/staffing issues in the

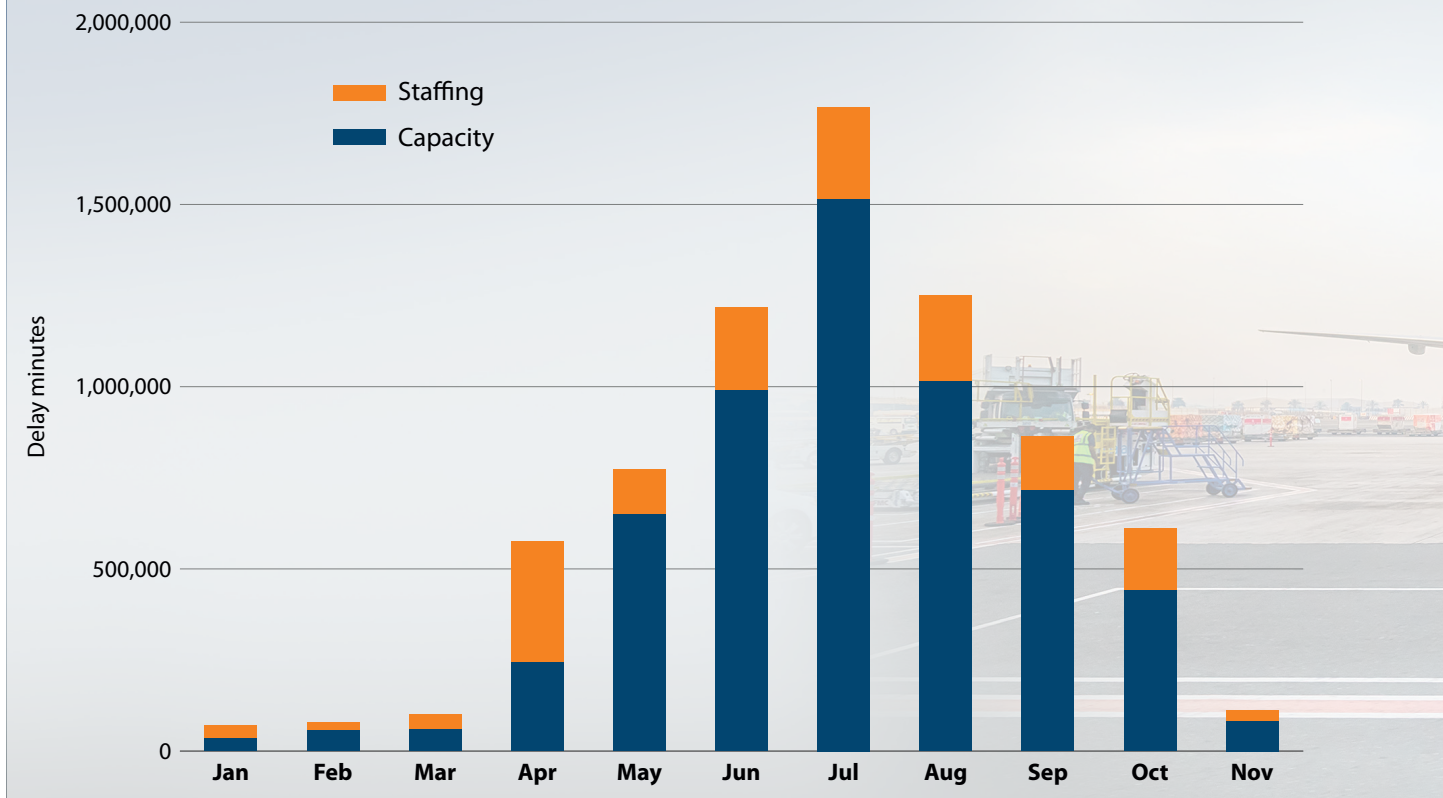
European **en-route airspace**. It looks in more detail at the different understanding of what ATCO mobility means and can deliver, what ANSPs are already doing to increase capacity through mobility, the challenges and the enablers.

What does the 2022 ATFM delay situation look like?

For January to November 2022, capacity delays (mostly caused by a lack of staff) and staffing delays together amounted to 7.43 million minutes. Over this period, there were 8.56 million flights (figure 1).

To put this figures into a wider perspective, the total en-route ATFM delay for the same period (including weather, equipment outages, special events, accidents, environmental issues, aerodrome capacity, etc.) was 15.7 million minutes. Therefore, delay due to capacity and staff shortages accounted for approximately 47% of the total en-route ATFM delays.

FIGURE 1: ATC CAPACITY AND STAFFING DELAYS IN 2022



“delay due to capacity and staff shortages accounted for approximately 47% of the total en-route ATFM delays”

How much is this costing?

Figure 1 show that the total delay incurred by lack of capacity and ATC staff shortages amounted to 7.43 million minutes for the first 11 months of 2022. Using the European airline delay cost value of €109/minute² of delay, this has cost airlines over €800 million so far in 2022.

The costs for ANSPs (and, ultimately for the airspace users paying route charges) to reduce capacity/staffing delays are far more complex and indirect. Any estimate should include an evaluation of the cost of permanently employing, training and maintaining an ATC staff compliment that would be able to meet the capacity and staffing requirements during peak traffic; however, this may create an oversupply during medium to low traffic periods. ANSPs may need to be better incentivised (for example, through the Performance Scheme) in order to provide a service that minimises the overall cost to European aviation (including the cost of delays).



Where are the delays?

Delays due to capacity and staff shortages are not Europe-wide but rather are concentrated around certain ANSPs and the areas/routes with most traffic, ranging from the NW↔SE flows between UK and Turkey, and the SW↔NE flows between Canary Islands and Germany. The ACCs with the highest levels of capacity/staffing en-route ATFM delay are shown below, together with an indication of the capacity/staffing delay per flight in that ACC's area.

ACC	ICAO code	En-route delay cap/staf	En-route delay cap/staf per flight
Karlsruhe	EDUUUAC	2,638,083	1.73
Budapest	LHCCACC	669,237	0.83
Marseille	LFMMACC	395,315	0.41
Bremen	EDWWACC	336,935	0.82
London	EGTTACC	334,312	0.20
Warsaw	EPWWACC	329,072	0.59
Belgrade	LYBAACC	280,133	0.40
Zagreb	LDZOACC	268,166	0.42
Paris	LFFFALL	248,623	0.26
Reims	LFEEACC	245,208	0.29
Barcelona	LECBACC	148,125	0.18
Madrid	LECMALL	121,381	0.12
Sarajevo	LQSBACC	110,827	0.32
Zurich	LSAZACC	78,361	0.12
Brussels	EBBUACC	74,928	0.16
Milan	LIMMACC	67,838	0.08
Geneva	LSAGACC	64,453	0.12
Seville	LECSACC	59,836	0.15
Athens	LGGGACC	49,631	0.08
Vienna	LOVVACC	46,481	0.05

² Cook, A., Tanner, G. (2015). 'European airline delay cost reference values – updated and extended values', University of Westminster.

“total delay incurred by lack of capacity and ATC staff shortages....has cost airlines over €800 million so far in 2022”

How many ATCOs do we need?

The Network Manager High Level Report to the Network Management Board³ detailing the Network's performance for 2017, provided an overview of the ATCO shortage and plans to recruit new ATCOs. With some assumptions made on the data provided, it is possible to infer that at the time, between 500 – 700 more ATCOs were needed to enable all airspace sectors to be open when demand required.

There is little evidence that this shortage of ATCOs has reduced since then. Instead, the current number of additional ATCOs needed is likely to have **increased above 700**.

A deeper dive into ATCO mobility

A previously mentioned, ATCO mobility has previously had **strong geographic associations**, meaning that mobility implied a physical relocation of an ATCO from one ACC or ATS unit to another. This typically happened within an ANSP/State, and less frequently, between ANSPs/States.

Intra-ANSP Mobility	Intra-European Mobility
<p>This is currently the most frequent type of mobility. ATCOs move from one ACC to another, or from one rating discipline to another (e.g. they start as a tower controller, then move to approach control, and a few years later, become an area controller).</p> <p>This type of mobility is often motivated by career progression, however there is usually a solid correlation between this type of mobility and the demands of the airspace that an ATCO progresses towards. There are a number of ANSPs where the demands of their most complex and busy airspaces require that ATCOs have proven experience as area controllers prior to joining that ACC. Conversely, there are some ANSPs where the ATCO population moves from the complex/busy ACCs to less busy ACCs as they approach the last years of their ATC career.</p>	<p>When the European Commission Regulation (EU) 2015/340⁴ relating to air traffic controllers' licences was first published in February 2015, one of the key reasons cited for establishing a common licensing scheme for ATCOs was to enable mutual recognition of licences and facilitate the free movement of air traffic controllers across Europe. From an ATCO mobility perspective, this meant easier relocation from one European country to another.</p> <p>In the early years of the implementation of this regulation some ATCOs did take the opportunity to move to new countries, however the numbers were not significant.</p> <p>Furthermore, the populations mostly likely to physically relocate were student ATCOs who, having completed Initial training, were looking to find a job in another country. As is the case in other industries, family and social issues make it more difficult for older, established ATCOs to relocate.</p> <p>In addition to the normal challenges of relocating to a new country, there can be additional national requirements impeding mobility for ATCOs, relating to language, education and citizenship.</p>

³ Action Paper. Network Manager High Level Report. NMB/18/21/4. 26.3.18

⁴ Commission Regulation (EU) 2015/340 of 20 February 2015 laying down technical requirements and administrative procedures relating to air traffic controllers' licences and certificates pursuant to regulation (EC)

*“of the key reasons cited for establishing a common licensing scheme for ATCOs was to...
facilitate the free movement of air traffic controllers”*



More recently, an additional understanding of the possibilities of 'ATCO mobility' has entered the discussion.

Cross-border ATC Provision

This type of mobility does not entail the ATCO physically moving location but rather they control airspace that is not co-located with (or near to) the ACC where they are based.

Technological advances have enabled inter-operability of ATC systems, and therefore the ability to conduct CNS services at longer ranges, including in airspaces outside the State. The primary applications today are delegations of small pieces of typically contiguous airspace, either on a permanent basis or contingent on specific circumstances (such as the failure of systems in a neighbouring state).

These arrangements are subject to binding State agreements and can be fraught with issues of liability and application of national legislation. Nonetheless, it is significant that inter-operability has opened up possibilities to progress from delegation of air traffic services for the purposes of contingency, to the sharing of the provision of the air traffic services (and importantly, the sharing of ATCO resources) of larger portions of airspaces on a routine basis.

It is this notion of ATCO mobility (i.e. cross-border operations) that has attracted the most attention as a potential way to resolve capacity shortfalls and ATCO staff shortages. Scalability is an attractive feature of this approach as it gives flexibility to assign controllers to the sectors where the need is the greatest at any given moment, irrespective of the national boundary or ACC in which the controller is located.

If it is possible for two ANSPs to share the air traffic management of an airspace that covers the common boundary of two States, then technically it should be possible for this idea to be expanded to include controllers in one State/ANSP controlling airspace in another State/ANSP. This could happen as a routine agreement, or when one ANSP does not have enough ATCOs to enable the full capacity of their airspace to be used at any given time.

*"Technological advances have enabled inter-operability of ATC systems,
...including in airspaces outside the State"*

Examples of what ANSPs are already doing with cross-border operations and mobility

Maastricht UAC

For 50 years, MUAC has provided cross-border operations as a multi-national, civil-military ANSP, managing air traffic in the upper airspace of Belgium, Luxembourg, The Netherlands and the north-west of Germany. Although the airspace covered is cross-border, the air traffic controllers are all based in the same facility in Maastricht. MUAC is expanding its intra-ANSP mobility by actively planning and executing the extension of additional Non-Native Sector endorsements. These so-called 3rd endorsements are planned for both civil and military operations. In addition, MUAC is cross-training supervisory staff to yield further efficiencies.

FINEST Project

ANS Finland and the Estonia ANS recently launched a project to implement a cross-border operation by merging the Helsinki FIR and Tallinn FIR between FL95 and FL660⁵. The objective of the project was to enhance and optimise traffic flows irrespective of the national boundaries. Sector configurations would be based on different traffic flows throughout the day and air traffic controllers in both ACCs would be capable of working any of these sectors. They would effectively share technical and ATCO resources to manage the overall airspace efficiently. A major enabler for this type of project is the implementation of a common technical environment (e.g. one FDP system for both); however to be successful, they would also need to harmonise their operating procedures, and establish a co-ordinated rostering system for ATCOs in both ACCs.

Hungarocontrol providing ATS in Kosovo

In 2014, the North Atlantic Council accepted an offer by Hungarocontrol to provide air traffic services over the Kosovo upper airspace⁶. The airspace remains under KFOR/NATO authority but the controllers who provide the air traffic services in the Kosovo airspace are located 700km away, in Hungarocontrol's ACC in Budapest.

This is an interesting case, as controllers normally gain a certain amount of knowledge about the traffic flows and conflict hotspots in the airspaces that are adjacent to their

own. This is because they are exposed to this traffic daily and often, cross-border co-ordination is part of the solution to traffic conflicts. However, in the case of Hungarocontrol ATCOs, they assumed control of the Kosovo airspace without prior live traffic exposure.

Skyguide – Virtual Centre

Although not an international cross-border operation, Skyguide is in the process of establishing a virtual centre that aims to maximise airspace capacity within Switzerland. It currently has two ACCs (Zurich and Geneva), each with their own controllers who are licensed to operate only in the sectors in their respective ACCs. The aim is to 'virtually' merge the two airspaces and ACCs so that any controller in either of the ACCs is able to control any portion of the Swiss airspace.⁷ This will ensure that staff can be assigned to work the sectors where there is greatest demand.

Enablers for further cross-border ATCO mobility

For ATCO mobility based on cross-border operations to succeed a number of enablers are necessary:

- Willingness of States to delegate/share the provision of ATS taking into account responsibilities for sovereign airspace and national security;
- An airspace architecture that is designed to dynamically adjust to capacity demands and accommodate air traffic flows without consideration of national boundaries;
- Standardised en-route ATC procedures and working methods that makes transitioning from one sector group to another seamless;
- Inter-operable ATM systems;
- A financial/business structure that provides the reward/incentive needed to justify the required investment in equipment and training.

⁵ eans.ee/en/tegevused/arendustegevused/fines

⁶ [Nato.int/cps/en/natohq/news_181385.htm](https://nato.int/cps/en/natohq/news_181385.htm)

⁷ [Skyguide.ch/company/innovation/blueprint/virtual-centre-touchdown](https://skyguide.ch/company/innovation/blueprint/virtual-centre-touchdown)

Challenges to cross-border ATCO mobility

Although technically possible to achieve, there are a number of other issues that make cross-border mobility challenging to implement.

National Security

Any undertaking that enables ATCOs residing in one State to provide air traffic services (ATS) in another State (be it through delegation of air traffic services, or sharing of the service) will require careful consideration of the national security implications. Under the Convention on International Civil Aviation (the Chicago Convention), each State has complete and exclusive sovereignty over the airspace above its territory. While sovereign airspace cannot be delegated, the responsibility for providing ATS can. However, in the current political climate, States may not be willing to authorise either delegation of ATS, or sharing of ATS in portions of their airspace.



Staffing during periods of high demand

Busy periods tend to occur at similar times for all ANSPs, especially neighbouring ones. As a result, even in a cross-border operation where shared resources and joint rostering is implemented, ANSPs may not be able to provide extra capacity across a border when it is needed – as they are also operating at maximum capacity.

Training and maintaining endorsements

In order for an ATCO to be able to take on the control of a sector normally controlled by another ACC, they will need to be trained, a process that uses the capacity both of that ATCO and also of the training units.

Moreover, most airspaces where there are staff shortages, are also airspaces that are operating at capacity and have complex traffic patterns and conflict zones. This creates an environment where acquiring the required competencies for these sectors cannot be done in a gradual and systemised way. Effectively, the trainee is ‘thrown in at the deep end’ because there is no shallow end. Although simulations can provide familiarisation with traffic flows, systems and procedures, ATCO simulators (even high-fidelity) are not able to replicate the live environment that changes based on the variable behaviours and actions of ATCOs in adjacent sectors and flight crews.

The ATCOs will also need to maintain the validity of endorsements, which typically includes working a defined number of hours within set time periods. While this may be easily achieved during busy seasons, it may be less more difficult during the quieter seasons. ANSPs would need to consider the cost of maintaining the endorsements during non-peak months vs allowing these endorsements to lapse and the time/cost for the ATCOs to regain them the following peak season.

“they will need to be trained, a process that uses the capacity both of that ATCO and also of the training units”

ATCO 'conversion' training

In this paper, we use the word 'conversion' to indicate that an ATCO moves from controlling one airspace to another, and a pilot one aircraft to another. This is to keep the language consistent. In practice, an ATCO 'conversion' is when an ATCO continues to work in the same airspace sectors but something fundamental has changed (e.g. new ATM system, restructuring of the sectors and procedures, etc.). When an ATCO moves from one set of sectors to new set of sectors, they are re-training for a new rating endorsement.

When a pilot converts from one aircraft type to another, the training time required is relatively short. By way of example, the Airbus A319/A320/A321 all use the same philosophy for flying and use of automation, so although there may be some changes in syntax when the pilot interacts with the automation, the time taken to 'convert' can be as short as one day. If they then switch to an A330, then it would take four simulator sessions to get the new rating.

If the conversion is from one aircraft family to another, this takes longer. For example, converting from an A320 to a B737, or vice versa, takes between two to three months.

When an ATCO converts from one set of sectors to another, the length of time it takes is dependent on a number of factors that affect the philosophy of how the airspace is managed. These include the similarity between:

- the airspace structures and class;
- flight level arrangement (e.g. France has a North/South FL split vs Germany has East/West FL split);
- traffic flows and vertical profile behaviour (e.g. majority parallel routes with small FL adjustments vs crossing routes and significant climbing/descending movement);
- aircraft types operating in sectors (e.g. all similar performance vs mixed performance vs military/civilian mix);
- conflict complexity and conflict resolution strategies (e.g. sequencing for hand-over vs same track speed management vs crossing track speed/track solutions);
- traffic density;

- predominant weather phenomena and environmental conditions;
- ATM systems and tools available;
- team configurations (planner + executive vs single person);
- complexity of procedures and number of 'exceptional' procedures.

When an ATCO acquires competence in a particular airspace, they are demonstrating that they are able to manage air traffic in a distinctive environment that has a specific control philosophy and set of factors affecting their decision-making. It is their understanding of these factors and the consequent automation of certain behaviours in this environment that enables them to maintain air traffic safety and efficiency. Therefore, if they move to a different airspace with a different combination of factors, the required competences will remain the same; however, they will need to acquire a new set of behaviours and decision-making strategies. In many instances, the change in factors will require the ATCO to unlearn some of their automated behaviours and acquire new ones.

In addition, the number of scenarios that the ATCO will need to acquire competence in, to manage the new sectors, has an impact on the training duration. Clearly, the fewer the scenarios, the shorter the training. Scenarios are the predominant patterns and procedures for a set of sectors. Changes in scenarios are driven by events such as seasonal demands for particular routes, seasonal weather, activation of restricted airspaces, changes of runways and consequent arrival and departure routes, airspace configurations in adjacent airspaces, etc.

There is one final significant impact on the length of time it takes for an ATCO to 'convert' to a new airspace. As pressure has mounted to enable enhanced flight efficiency, ACCs have introduced, in addition to their standard procedures for each scenario, multiple different sets of procedures that take advantage of exceptional or atypical changes to the environment. However, there is a trade-off; while this does enhance flight efficiency, the consequence is that the ATCO training time is increased.

"When an ATCO converts from one set of sectors to another, the length of time it takes is dependent on a number of factors"

While there are sound reasons for why it takes so long to train an ATCO in a complex factors airspace, areas worth investigating are methods and techniques to improve pass rates, and incremental gains on training durations. There are examples of conversions being made safely within a relatively short period and this experience could be usefully applied to ensure that the conversion process is not excessively long, which is clearly a barrier to mobility.

KEY CONCLUSIONS

1. ATC capacity/staff shortages are a major cause of delays in Europe, costing over €800 million this year. As traffic recovers and grows, this is likely to continue.
2. ATCO mobility could help. This can either be through ATCOs moving within/between ANSPs – or by an ANSP providing a service outside its borders
3. Technical and regulatory enablers already exist to support ATCO mobility solutions but there are obstacles, such as sovereignty and national security issues.
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