Assembling airspace: The Single European Sky and contested transnationalities of European air traffic management

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Abstract

The Single European Sky (SES) encompasses a series of legislative and regulatory measures reflecting a vision for reforming Air Traffic Management (ATM) in Europe to ultimately transcend national control of airspace. This article considers SES via the conceptual framing of the sociotechnical imaginary, and finds that the embedded, distributed and interpretive character of European ATM invites further conceptualization around how actors may need to engage with infrastructural imaginaries. How is an imaginary perceived and interpreted across its spatial reach? How do the standpoints, interests and interpretations of different groups embedded within infrastructural space play a role in the construction of that spatiality and envisioned territorial assemblages? Do these standpoints and interpretations extend to the perceived imaginings of others, and what might this imply for how sociotechnical imaginaries and spatialities are co-produced? The article outlines the history of European ATM through to the current status of SES. By describing contested negotiations involving the European Union, Eurocontrol, state bodies and organized labour, SES is used as a case study to demonstrate how relations between national sovereignty and transnational governance can be imagined in different ways through ATM. The article identifies a series of interactions and tensions between interpretations of SES, involving instances of perceived appropriation by some stakeholders on the part of others and concerns over emergent risks and uncertainties. The study identifies how relations and interpretations between stakeholders, states and transnational bodies shape and are shaped by the discursive and material projection of assemblages of technology, data, space and political rationality. These projections map European airspace in different ways. Negotiating the SES imaginary has entailed a politics of suspicion and risk that reflects a certain instantiation of interpretive flexibility, involving concerns over how SES is imagined by others.

Keywords

air traffic management, infrastructures, European integration, transnational governance, sociotechnical imaginaries

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Introduction

Systems that support transport, energy, telecommunications, water and other resources deemed instrumental for contemporary individual and collective livelihoods have been described as critical infrastructures (Hutter, 2010). Such infrastructures can be regarded as 'built networks that facilitate the flow of goods, people or ideas and allow for their exchange over space' (Larkin, 2013: 328). Their capacity to 'support collectivity at the material level' (Opitz and Tellman, 2017: 171), has drawn attention to the socio-political dimensions of infrastructures (see for example Barry, 2013; Collier, 2011). Research aligned with Science and Technology Studies (STS) has explored infrastructures as a means of reconceptualizing politics and polities (Rowland and Passoth, 2015). This line of research has examined a range of examples, including oil pipelines (Barry, 2013), roads (Guldi, 2012), energy (Mazur, 2013; Bouzarovski et al., 2015) and the internet (Bowman, 2015). Such work has been viewed by Rowland and Passoth (2015) as extending the tradition of political-technological 'co-production' (Jasanoff, 2004).

Following Foucault, Larkin (2013) has observed that the confluence of political rationalities and infrastructural projects represent emergent 'apparatus of governmentality' (Foucault, 2010: 70; Larkin, 2013), whereby socio-material assemblages and political thought and action (Rose et al., 2006) territorialize subjects and spaces, rendering them measurable and governable (Elden, 2010; Rose-Redwood, 2006). By connecting populations, managing livelihoods and facilitating governability, infrastructures shape notions of collectivity and understandings of security or economic performance (Opitz and Tellman, 2017; Painter, 2010). Infrastructures are therefore of key interest to STS and political studies not only because they manage the flow of individuals or resources, and shape how those movements are known, but also because infrastructures may embody certain political rationalities. Through infrastructures, these rationalities can extend beyond national borders (Bouzarovski et al., 2015). Such projects may reflect ambitions for political integration, such as those situated across and beyond the European Union (EU), and recent work has begun to address this relationship (Opitz and Tellman, 2017).

While infrastructures play a significant role in the co-production of territory, knowledge and governance, further questions concern how such rationalities emerge over time and how infrastructural plans and visions gain consensus or become resisted. Much STS research has focused on the social dimensions of technological expectations, plans and promises (Borup et al., 2006; Hielscher and Kivimaa, 2019; Korsnes, 2016), which may interrelate with broader socio-political visions (Felt et al., 2008; Jasanoff and Kim, 2015). The term 'sociotechnical imaginary' has been used in a growing number of studies to frame how scientific and technological initiatives are co-produced (Jasanoff, 2004) with 'collectively imagined forms of social life and social order' that encompass notions of normatively 'good' societies (Jasanoff and Kim, 2009: 120). Among other modalities, the sociotechnical imaginary has been proposed as a means of framing how science and technology co-produce the territorial reach of political institutions (Jasanoff, 2015). Rather than focusing on disputed or uncertain territories (Leuenberger and Schnell, 2010), sociotechnical imaginaries studies have however tended to compare developments within relatively well-established political boundaries, such as individual nation states (Jasanoff and Kim, 2009) or between and across EU member states (Felt, 2015; Jasanoff, 2005; Mager, 2017). Research focused on the construction of European sociotechnical imaginaries has portrayed the EU as a 'multiply imagined community' (Jasanoff, 2005), which challenges efforts to form stable shared visions. For example

Mager's (2017) study of data protection legislation claims that this distinctly 'European' imaginary was made and unmade in different spaces due to 'different visions and values rooted in different historical experiences, socio-political traditions, economic cultures and ideological foundations' *(*Mager, 2017: 242*).*

What is less clear from studies of transnational sociotechnical imaginaries is how the relationship *between* these spaces of making and unmaking may be conceptualized, and to what extent different spaces and forms of imagining are linked and interdependent. Such questions point to the possible role of interpretive flexibility in shaping sociotechnical imaginaries (Pinch and Bijker, 1984), when considering how interest groups may hold differing interpretations of a sociotechnical system, and how these differing interpretations may vie to control anticipations of the future. Introducing interpretive flexibility opens up a means of conceptualizing sociotechnical imaginaries as subject to networked and interdependent forms of imagining.

Infrastructures and related plans embed actors and objects in potentially rigid socio-material assemblages and create interdependences across spaces (Bouzarovksi et al., 2015; Smith and Tidwell, 2016). In drawing attention to this embeddedness, this article seeks to challenge assumptions of the type of agency that may be involved in participation within imaginaries. This article considers how stakeholders may be compelled to engage with imaginaries in ways which do not necessarily reflect shared perceptions of social good but through being already embedded within an infrastructural assemblage. Sociotechnical imaginaries literature has previously examined how different groups may imagine infrastructural plans differently, perceiving risks and potential negative consequences as opposed to purely positive aspects (Jasanoff and Kim, 2009). Yet the embeddedness and potential interdependence of actors within infrastructural plans illuminates the hitherto underexplored possibility that risk perceptions may also extend to the intentions and imaginings of others embedded within the same plans.

The potentially embedded, distributed and interpretive character of infrastructures hence raises a series of questions which invite further conceptualization of sociotechnical imaginaries as a means of contributing to STS literature. How is an imaginary perceived and interpreted across its spatial reach? Do the standpoints, interests and interpretations of different groups embedded within infrastructural space play a role in the construction of that spatiality and envisioned territorial assemblages? Do these standpoints, interests and interpretations extend to the perceived imaginings of others, and what might this imply for how sociotechnical imaginaries and spatialities are co-produced?

While imaginaries studies have paid attention to spatiality in terms of studying how visions translate within and across local, regional, national and transnational spaces (Jasanoff and Kim, 2009, 2015; Kim, 2018; Levanda et al., 2019; Mager, 2017; Smith and Tidwell, 2016), they have often tended to assume these spatial levels as given and distinct. By tracing the negotiations and deliberations concerning envisioned plans for European air traffic management, this article draws attention to how spatiality is itself co-producible with the negotiation of a sociotechnical imaginary. Hence this article considers spatiality as a possible outcome of sociotechnical imaginaries as opposed to simply a field in which sociotechnical imaginaries are shaped.

Air traffic management (ATM) is a key transnational infrastructure (Alemanno, 2011), regarded as instrumental to regional economic competitiveness across and between areas such as Europe and Asia, and also as a key driver of contemporary continental integration and

globalization (Eran-Tasker, 2013). ATM presents a significant and relevant challenge to studies of technology and transnationalism in terms of understanding how space is rendered governable. While STS research on infrastructures has characterized them as emergent entanglements of materiality and politics (Rowland and Passoth, 2015), the transnational dimensions of ATM, and its technological and organizational complexity, present a significant challenge to understanding the conditions of possibility for its governance. This challenge relates to the question of tracing what forms governing authority may take given tensions between national sovereign rights to retain control of airspace, versus the perceived need for increased inter- and transnational cooperation, which is complicated further by the presence of overlapping institutions.

Continental Europe's dependence on its densely saturated airspace was brought into sharp relief by the 2010 Eyjafjallajökull crisis. The disrupted access to airspace during the crisis resulted from hitherto unanticipated concerns about the effect of heightened quantities of volcanic ash on aircraft (Hutter and Lloyd-Bostock, 2013). The enduring system of arranging ATM around national borders, and the perceived lack of coordination among national authorities was regarded as precipitating the crisis (Alemanno, 2010). Following the crisis, some commentators advocated an acceleration of ongoing efforts to advance a vision of European ATM known as the 'Single European Sky' (SES) (Alemanno, 2011). SES refers to a series of legislative and regulatory initiatives aimed at reforming European ATM to ultimately move away from state control of airspace to an integrated system, organizing airspace instead around areas of traffic concentration in order to maximise efficiency. SES has been expressly promoted as a means of facilitating economic growth across Europe, benefitting traveller experience, and ameliorating the environmental impact of air travel (Eurocontrol, 2017). A key aspect of SES has been the introduction of a 'Performance Scheme', which has introduced new metrics to evaluate ATM across Europe.

SES involves a variety of participating stakeholders, including organizations and governance arrangements that overlap and interact with the EU and its executive arm, the European Commission (EC). The EC works with Eurocontrol, the latter an inter-governmental organization that pre-dates the current EU system, and that includes non-EU nations within its membership alongside EU member states. SES affects a variety of national-level actors, including governments, Air Navigation Service Providers (ANSPs), which employ air traffic control officers (ATCOs), and organized labour. Commercial actors such as airlines and air navigation technology producers also hold interests in the reform of European ATM (Hutter and Lloyd-Bostock, 2013). It is within this heterogeneous landscape that various SES initiatives have been attempted and proposed (see Table 1 for a glossary of terms and abbreviations).

The article draws upon a range of data sources. (a) I collected documentary material describing SES and related initiatives, together with websites, press releases and conference presentations that outline responses to various SES-related proposals. (b) I build on in-depth semi-structured interview and focus group data, representing a total of eighteen respondents. This included consultations with high-level representatives from the EC, other EU organizations and Eurocontrol (in what follows focus group data is cited with the abbreviation 'FG'). In addition, I conducted a field visit at the operational headquarters of a major European ANSP, which included interviews with ATCOs, support staff and representatives of their trade union. Other respondents included a management consultant who had worked extensively with a national civil aviation authority in response to SES plans. A professional pilot was also interviewed. (c) A participant observation exercise at a two-day

ANSPs	Air Navigation Service Providers: Organizations who employ Air Traffic Control Officers to oversee the routing of aircraft across airspace
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
CS	Centralized Services: An initiative proposed by Eurocontrol to reform ATM information systems to assist national ANSPs to meet targets set under the SES Performance Scheme
DGCA	Director General Civil Aviation: A role which takes responsibility for the oversight of civil air transport in a specific state
EASA	European Air Safety Agency: An EU body formed in 1997 to regulate air safety
EC	European Commission. The executive cabinet of the EU, responsible for proposing and implementing EU legislation.
EU	The European Union
Eurocontrol	Also known as the European Organization for the Safety of Air Navigation. It comprises EU Member States, the EU as a separate representation, and a number of non-EU Member States
FAB	Functional Airspace Blocks: Introduced in SES2, these are intended to function as the constituent elements of SES, grouping airspace into geographic regions.
Gate One	A grouping of 13 ANSPs representing a continuous airspace region linking the Baltic Sea, the Balkans and the Black Sea
SES	Single European Sky: The broad term used to describe a series of legislative and operational reforms to European air traffic management
SES1	The first package of SES legislation passed by the European Parliament in 2004
SES2	The second package of SES legislation passed by the European Parliament in 2009

SES2+	An additional series of measures proposed by the European Commission intended to implement the SES vision

Table 1. Glossary of Terms

meeting of approximately 200 ATM stakeholders in Europe brought together ATCO representatives from most European countries (EU and non-EU), trade unionists, Eurocontrol representatives and other SES stakeholders.

The methodological strategy involved three lines of enquiry. First, interviews focused on the history of stakeholder organizations and their roles in SES. Second, fieldwork investigated relations between actors before and since the emergence of SES. Third, representations of SES-related initiatives made in official literature were compared with the perceptions of respondents, and with views expressed in other sources. These enquiries led to the triangulation and corroboration of a series of themes which informed the development of a comprehensive overview of the evolution of European ATM and SES.

This article outlines the history of European ATM through to the current status of SES. The first section describes early Western European responses to commercial jet air travel in the 1950s, which led to the first international regime in the form of Eurocontrol, pre-dating EU involvement in air transport. Next, I outline the emergence of successive pieces of SES legislation, and describe key constituent elements, including the Performance Scheme and Functional Airspace Blocks (FABs). I describe how SES has shaped the organizational landscape of European ATM, and the increasing influence of the EU system with which Eurocontrol has had to contend. I explore responses to successive SES initiatives. Finally, I describe how Eurocontrol has pursued a renewed role in SES via its 'Centralized Services' (CS) plans. By exploring these areas, I identify a series of interactions and tensions between contending visions of SES, involving instances of perceived appropriation by some stakeholders on the part of others and concerns over emergent risks and uncertainties.

While vital for the safe and efficient functioning of aviation, ATM also is and has been a contest for geographic space. ATM projects and politicizes claims to and about technological arrangements that produce knowledge about space. ATM, therefore, is a significant arena of interaction where European integration can be seen to be negotiated, and where contending potentialities of transnational governance and visions for European airspace have been expressed. The SES case study demonstrates how relations between national sovereignty and transnational governance can be constructed in different ways through ATM. Politics has infused itself into ATM infrastructure over time, but ATM also has co-produced politics via emergent perceptions of risk, uncertainty and contingency. My study identifies how relations between stakeholders, states and transnational bodies shape, and are shaped by, the discursive and material projection of assemblages of technology, data, space and political rationality. This article thus contributes to understandings of sociotechnical imaginaries by highlighting the role of standpoint and interpretive flexibility of interests as constructive and deconstructive dynamics.

Eurocontrol and the roots of ATM governance

International agreements concerning civil aviation have a distinct history. The 1919 Paris Convention, for example, formalized arrangements for the use of aerodromes by domestic and foreign aircraft (Huet, 2011: 147). The 1944 Chicago Convention legally enshrined the right for sovereign nations to control their own airspace. Early forms of European cooperation on ATM, which led to the formation of Eurocontrol, can be traced to the end of the 1950s, as commercial jet aircraft began to supersede piston-engine models. The ability to fly faster and further led to ATM becoming recognized as a transnational issue by a number of Western European governments. Within Western Europe, the idea of creating a region of airspace controlled by a single body began to emerge. In 1960, six Directors-General of Civil Aviation (DGCAs), responsible for the oversight of civilian air transport in the UK, France, West Germany, Luxembourg, Belgium and the Netherlands, met at an international conference. They discussed ways of working together in the face of the increasing ATM challenges posed by technologically advancing civil aircraft. The Eurocontrol Convention was agreed in 1963 (Eurocontrol interview, 2014).

Cold War tensions affected co-operation within the Eurocontrol framework. Eurocontrol's two nuclear powers, the UK and France, were reluctant to relinquish too much sovereignty and control to an international organization. While these two nations stepped back from the vision of a fully integrated airspace across its member states, Eurocontrol nonetheless had a partial success in creating the Maastricht Upper Area Control Centre. Through this Centre, Eurocontrol continues to provide ATM services for an area 24,500 feet over Belgium, Luxembourg, the Netherlands and North-West Germany. This represents the second busiest region of upper airspace in Europe, after London.

Membership of Eurocontrol has increased from the original six members to a current number of 41 (as of March 2020), including both EU and non-EU member states. The EU has parallel membership alongside its member states. Membership was seen by a senior Eurocontrol figure as potentially extending to between 44 to 55 nations (Eurocontrol interview, 2014). Iceland and Estonia are the most recent applicants, the latter gaining full Eurocontrol membership in 2015. A state becomes a Eurocontrol member once the Convention is ratified by its national parliament. A weighted majority voting system exists for decision-making. Eurocontrol member states are represented by their respective heads of civil and military aviation.

In addition to a wide membership extending beyond the EU, Eurocontrol possesses demonstrable technical and intellectual capital. Eurocontrol runs a training centre in Luxembourg and a research and development centre located in France. Eurocontrol can demonstrate a significant history and status as a centre of ATM expertise, laying claim to numerous innovations which are now regarded as integral to contemporary ATM. These include innovations in short-term conflict alert systems to prevent collisions, and online systems to exchange flight data in real time. Eurocontrol has also devised key standards such as vertical separation minimum, used to regulate vertical distances between aircraft in the sky. Such standards and innovations have been recommended and adopted more widely by international bodies such as the International Civil Aviation Organization, a United Nations agency that has 191 member states.

Eurocontrol plays two other major roles in European ATM. First, it functions as the central body for the collection of airspace route charges on behalf of Air Navigation Service Providers (ANSPs), the organizations that employ air traffic control officers (ATCOs) to

guide aircraft across national airspace. Airspace routes were likened to motorways by one respondent from a leading European ANSP, complete with junctions and bends (ANSP Interview, 2014). Airlines are charged by ANSPs for the latter's services in guiding aircraft across routes over their airspace. These charges are ultimately factored into airline fares.

A second role for Eurocontrol is that of Network Manager of European airspace. A professional pilot likened this role to being the 'traffic police of the skies' (Interview, 2014). The Network Manager role was described elsewhere as a co-ordinating function to overcome incompatible ANSP systems, and to develop measures to enable information to flow around the European ATM system in order to be available at the right time at the right place (Eurocontrol interview, 2014). In its Network Manager role, Eurocontrol also monitors ATM performance in relation to traffic levels. While traffic levels dropped sharply following the 2008 global economic downturn, they recovered more rapidly than expected (Eurocontrol interview, 2014). Increases in traffic have led to heightened safety concerns. ANSP cost efficiency and the environmental impact of air travel represent additional high-level issues. European ATM was still regarded as significantly more expensive for users than US airspace. Improvements to routing may reduce mileage taken by aircraft through improved flight profiles, which may lower costs to airlines and aircraft emissions (Interview with professional pilot, 2014).

Eurocontrol can thus be regarded as a key actor in the shaping of European ATM. Eurocontrol was described by an official as the 'voice of the EC' in non-EU states. The term 'pan-European' sky was used by this official to describe how ATM co-operation may extend beyond the EU (Eurocontrol interview, 2014). As an intergovernmental body that includes EU and non-EU member states, Eurocontrol focuses on a relatively narrow technical agenda across its member's airspace, rather than pursuing high-level political union. In contrast, the emergence of the EU has brought with it a variety of initiatives that have sought to promote a supranational approach to numerous aspects of civil aviation, including ATM (Charokopos, 2015; Kassim and Stevens, 2010). This has included the formation of EU-based organizations such as the European Aviation Safety Agency (EASA), which currently works alongside Eurocontrol. EASA is tasked with formulating operational regulations for all areas of civil aviation across the EU, plus Switzerland, Norway, Iceland and Liechtenstein – the UK will leave EASA at the end of 2020 (BBC, 2020).

The concept of EASA emerged around 1997 (EASA FG, 2014), amid concerns over the perceived voluntary nature of co-operation on aviation safety at the time. Another driver was the perceived need to limit duplication of activity, such as safety certification, across EU member states. The granting of safety certification in various areas of aviation had been the responsibility of each individual state. The EC and industry led moves for a common safety regime that could avoid duplication of certification. This does not appear to have happened without some reluctance from European state authorities, who have not only lost the power of certification but also participation in relevant international fora, their places having been taken by EASA (EASA FG, 2014).

Discussions with EASA respondents highlighted Eurocontrol's role in addressing ATM during the rapid period of growth in civilian air travel during the 1950s and 1960s. EASA respondents regarded Eurocontrol as meeting a key need at a time when no other forms of organized co-operation existed. However, Eurocontrol's standard-setting capacity was viewed with some concern by EASA respondents, who regarded it as 'inappropriate' that such an organization could formulate rules with 'no political checks' (EASA FG, 2014). Eurocontrol's intellectual and technical capital was viewed as valuable but also problematic

for EASA, given that the latter now oversee Eurocontrol but do not have the full ability to challenge Eurocontrol's processes. This combination was described as 'difficult' by EASA respondents, and the relationship between the two organizations was regarded as complex. EASA respondents also regarded Eurocontrol as 'trying to get more power in the European Union' (EASA FG, 2014).

A Eurocontrol respondent described EASA as taking over from the former as the 'new regulator' for Europe (Eurocontrol interview, 2014). Eurocontrol was, however, still regarded as a key source of expertise upon which EASA relies. EASA respondents viewed the formulation of regulations as a complex task, requiring considerable technical knowledge of ATM, and acknowledged their continued dependence on Eurocontrol to supply such expertise.

While Eurocontrol remains a significant actor, the EU's heightened influence was regarded as having 'inhibited the initiative' of the former in operational areas (Eurocontrol interview, 2014). The rise of EASA is a significant example of how new organizations have taken over previous Eurocontrol roles. A senior Eurocontrol official described this a 'little bit painful' (Eurocontrol interview, 2014). Rules now emerge from EASA, while Eurocontrol's role appears to be moving toward supporting states in implementing these rules. Eurocontrol appears to have somewhat less agency in that their own proposals cannot now be shaped 'under a strictly speaking Eurocontrol initiative' (Eurocontrol interview, 2014). Instead, ATM solutions proposed by Eurocontrol must now be channelled through EU organizations such as EASA. Eurocontrol thus experiences a co-dependent but complex relationship with EU-derived institutions in terms of political and epistemic authority.

As the 20th century moved into the 21st, the EC has pursued formal legal arrangements to reform European ATM in order to promote efficiency of airspace use. The ultimate vision of successive legislative initiatives, encompassed by the term Single European Sky (SES), is to re-organize airspace governance on the basis of route concentration rather than national borders. The next section describes these initiatives and how they have affected European ATM.

Single European Sky (SES): From SES1 to SES2+

SES1: The EC intervenes

The 1999 Kosovo conflict for example has been regarded as a watershed moment for European aviation, and the experience of the Balkan Wars of the 1990s has been cited as a key shaper of the original rationale for SES (European ATM Meeting, 2014; Sultana, 2011). Ensuring safe functioning of civil aviation around airspace where military operations were taking place was seen as an 'unprecedented challenge' (Baumgartner and Finger, 2014: 31). The addition of large numbers of military aircraft to commercial traffic resulted in airspace closures, re-routing and the reduction of capacity (Sultana, 2011). This crisis was viewed as making ANSPs more conscious of the need to develop a better-integrated network (European ATM Meeting, 2014). It also made the EC aware of the risks of saturated airspace and problems with delays. A 1999 EC communication, 'The creation of the Single European Sky', described the situation as 'disastrous' (Huet, 2011: 152). It was critical of the inter-governmental solution promoted by Eurocontrol, which had published its own strategy for the 21st century:

> It is doubtful whether [Eurocontrol's strategy], which is based on Eurocontrol's traditional working methods, and does not contain a clear plan of action for the development and implementation of new concepts and procedures of air traffic management, is the right response if *major structural reforms* are not made both at a national and European level. (EC, 1999: 3, emphasis added).

This communication effectively represented the starting point of the EC's own vision for SES (Huet, 2011). It included proposals to pressure Eurocontrol 'to reform its working methods' (EC, 1999: 6). The creation of SES was framed as '*not simply a technical matter*', but instead as requiring 'a *political undertaking at the highest level* in order to support steps which in substance are no different from 1985 and the single European market or 1990 and economic and monetary union' (EC, 1999: 6-7, emphasis added). These statements indicate that the EC saw the re-shaping of airspace as a high-level project embodying the EU's overall political vision, as opposed to mere technical co-operation. The EC has subsequently sought to further link aviation with broader political aims, by encouraging candidates for EU membership to embrace principles of free market access, 'opening new market opportunities to the European aviation industry' (Charokopos, 2015: 56).

The first package of SES legislation, sometimes referred to as 'SES1', was passed in 2004 (European Parliament, 2004). SES1 brought ATM under the EU common transport policy (Alemanno, 2011: 7), and expressly stated that European airspace be re-shaped to reflect traffic flow concentrations rather than national borders. A second set of legislative measures ('SES2') sought more tangible changes.

SES2: FABs and the Performance Scheme

SES2 was adopted in November 2009 (European Parliament, 2009). It committed states to the formation of 'Functional Airspace Blocks' (FABs). FABs have been regarded as the constituent elements of SES, intended to group airspace into geographic regions that transcend national borders (Crespo and de Leon, 2011). As Figure 1 indicates, though, the current FAB arrangements, while encompassing groups of states, still display close contiguity with existing national borders. Shortly after SES2 was passed, the widespread disruption to air travel attributed to the 2010 Eyjafjallajökull eruption reinvigorated calls to accelerate the full implementation of SES as originally envisaged (Alemanno, 2010). The EC subsequently criticized member states for their alleged sluggishness in fully implementing FABs (Lawless, 2014).

FABs in their current form nonetheless function as a basis for the SES Performance Scheme, the latter also a product of SES2. The Performance Scheme has some origins in earlier work conducted on behalf of Eurocontrol at the beginning of the 21st century, which had identified areas for improvement among European ATM systems in terms of costs and capacity management (European ATM meeting, 2014). The current Performance Scheme endorsed by SES2 applies to the current (as of March 2020) 28 EU member states plus Norway, Switzerland and Bosnia-Herzegovina. The SES Performance Scheme obliges ANSPs, and the FABs in which they reside, to set a series of performance targets relating to metrics of safety, environmental impact, capacity and cost-efficiency. The planned liberalization of European ATM envisaged under SES ultimately seeks to facilitate free-market access to the sector, with the aim of improving ATM efficiency in order to benefit airlines and passengers through reducing fares (EC FG, 2014). These plans were cited as the rationale for the Performance Scheme. The Performance Scheme is intended to provide the future benchmarks through

which a reformed ATM may be evaluated and understood. However, the current Performance Scheme remains anchored to the state system.

While FABs have played a foundational role in the organization of the Performance Scheme, a number of respondents and interlocutors regarded them variously as ineffective or even moribund. One group of ANSP representatives opined that FABs 'haven't really worked' (ANSP interview, 2014). Some respondents described the UK-Ireland FAB as merely 'a badging exercise' which concealed the reality that the UK and Irish systems continue to operate separately (ANSP interview, 2014; Interview with transport consultant, 2014). A

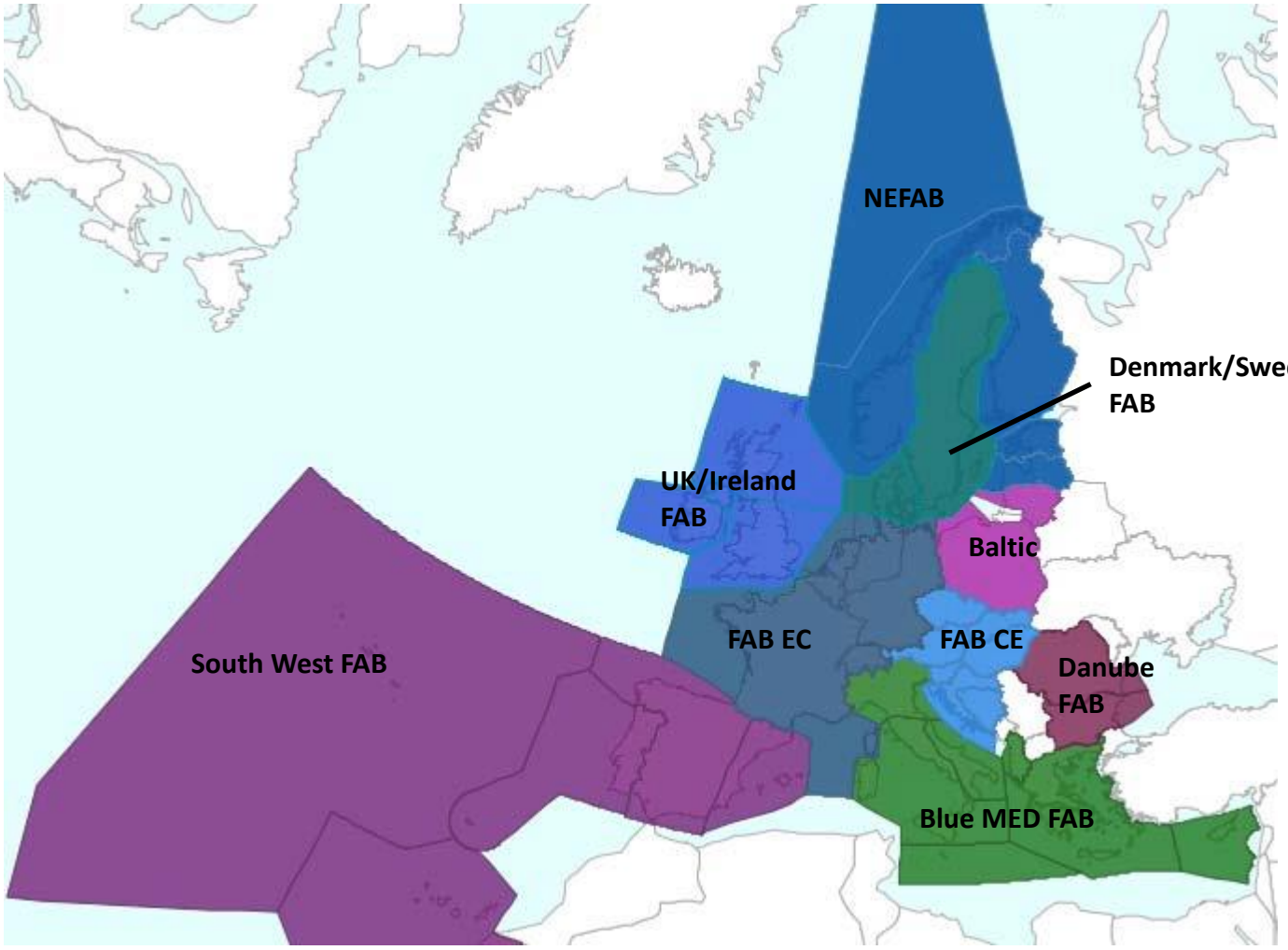

Figure 1. Current FAB arrangements (Eurocontrol, 2013). Reproduced with kind permission of EUROCONTROL / (c)2013 EUROCONTROL All rights reserved.

senior European ATM official even stated during a 2014 meeting that 'FABs are dead' (European ATM meeting, 2014). A focus group of EC representatives admitted that 'FABs became a tool of the state…. [O]ne sign of the failure of FABs is they perfectly follow

[national] borders' (EC FG, 2014). The manner of these relations was seen as reflecting obdurate state attitudes:

> Maybe at some other levels [states] like Functional Airspace Blocks, Single [European] Sky, but as soon as they see the results, there are serious negotiations … they have to give up something, and maybe lose something, they are much afraid to do so. And another thing is sovereignty, in case they lose it. (EC FG, 2014)

A number of respondents regarded the seemingly intimate relationship between some ANSPs and national governments as holding back the possibility of change. EC respondents reported that many European ANSPs were 'state-owned civil services', arms of the state, but able to influence state governments in return (EC FG, 2014). For example, it was claimed by them that the German ANSP has a 'direct line to the German government'. Elsewhere, a respondent said: 'As long as ANSPs are owned by the state, and you have ATCOs as civil servants as in France – they can go straight to the Paris government'. Hence in many cases, 'states are ANSPs' (EC FG, 2014). During another interview, one respondent from a leading ANSP claimed that 'the Irish State is the Irish provider' (ANSP interview, 2014).

During some observations and interviews, the Performance Scheme was regarded as facilitating greater transparency, making visible certain indicators relating to ATM efficiency (EC FG, 2014; European ATM meeting, 2014). Other findings suggested significant scepticism over performance targets. ANSPs are currently obliged to make performance plans, but doubts were expressed over whether state-level targets actually reflected reality:

> States submitted performance plans based on a low traffic forecast. The traffic that the forecast was taken as the low and the plans that are in place are to make the low forecast. And even today, the low forecast was one per cent [increase], the high forecast three per cent, and it is actually more than two. You can't really plan for a low forecast … de facto we are planning to not meet our targets. We are planning to fail … we have a situation where we are planning something fictitious … the performance plans are based on low traffic forecasts. (Eurocontrol official speaking at European ATM meeting, 2014)

Here, states were accused of manipulating the Performance Scheme by setting targets that could be easily met, but that reflected low increases in traffic flow conditions, rather than medium-to-high increases which this official claimed were really being experienced:

> To be frank, we do not believe the performance plans we discussed with these ANSPs. (Eurocontrol official speaking at European ATM meeting, 2014)

Other stakeholders were highly critical of the Performance Scheme. One representative of an international trade union group likened the Performance Scheme to the five-year plans associated with fallen Communist regimes. This trade unionist doubted whether the Performance Scheme had improved openness, or had simply allowed states and national ANSPs to 'hide behind papers', creating a façade of transparency, and enabling state governments and employers to use the Performance Scheme as an excuse to withhold benefits and remuneration to ATM workers:

> How many ANSPs are using [the Performance Scheme] to say, 'Sorry I can't give you any more money?' (Trade Union official, European ATM meeting, 2014)

Consultation processes concerning the Performance Scheme are mandatory at the state level, and there are wider consultation systems, known as 'Social Dialogues', which take place at FAB level. Some EC respondents expressed concerns that these consultation activities took considerable time, and potentially led to performance targets being outdated even before they were introduced (EC FG, 2014). During a discussion at a European ATM meeting in 2014, a representative from an ATCO professional association of one European nation dismissed his country's Performance Scheme plan (European ATM meeting, 2014). This representative talked of how their employer had promised a consultation process, only to present a 1000-page document with a 48-hour deadline for ATCOs to respond to with feedback.

Other concerns related to the impact of the Performance Scheme on safety. During one exchange, safety culture was seen as threatened by 'arbitrary targets and processes which do not make sense' (Discussion, European ATM meeting, 2014). Whether the Performance Scheme may 'hinder or help' (European ATM meeting, 2014) safety emerged as a subject of considerable debate. While safety targets have been set, there are concerns that these do not reflect the underlying ontology of safety. The Performance Scheme has raised concerns over possible trade-offs, which may not be fully understood, between safety and efficiency. This was regarded elsewhere as 'an area of massive uncertainty' (ANSP interview, 2014). Similarly, another respondent claimed that the risks of SES were 'not well understood' (Interview with transport consultant, 2014). Concerns about such potential trade-offs led European organized labour groups to threaten action (ATCEUC, 2014; ETWF, 2014).

SES2+: Toward radical unbundling of ATM?

In 2013, the EC proposed another round of legislative measures known as 'SES2+', intended, as the name suggests, to supplement the previous SES2 package. Described on the EC website as an 'interim update of SES rules' (EC, 2016), SES2+ aims include giving airspace users more influence and a 'role in signing off major investment plans' (EC, 2016), as well as further development of the Performance Scheme.

SES2+ also proposes significant reforms to ATM 'support services', a term that potentially encompasses a range of functions, including surveillance, communications, meteorology, other data services, and engineering (Prospect, 2013). SES2+ proposes unbundling these services, taking them away from nationalized monopoly providers and bringing them within the scope of procurement rules 'to ensure a transparent selection of the provider offering the best cost/benefit ratio' (EC, 2016). This could open up support services to the free market.

An engineering support manager interviewed at an ANSP in 2014 expressed concern that SES2+ could lead to a scenario where a radar outage at their site could only be repaired through external engineers. If support systems were unbundled, this respondent suggested that the support department at the ANSP would not be able to directly fix the radar, as they are currently able. Under SES2+, it was perceived that such a task might entail having to call an outsourced company via an overseas telephone call centre (Field visit to ANSP, 2014).

SES2+ has raised other concerns among European ATM stakeholders (European ATM meeting, 2014). The notion of 'support services' as used in SES2+ literature has been regarded as lacking a clear definition (ANSP interview, 2014; Prospect, 2013). One leading national ATCO trade union perceived SES2+ as placing profit over safety, risking fragmentation, over-regulation and loss of capability (Prospect, 2013). This has been echoed at the European level by related international trade union associations (ATCEUC, 2014; ETWF, 2014).

Some aspects of SES2+ have also faced collective criticism from a bloc of Central and Eastern European ANSPs known as the 'Gate One' group (see Figure 2). Founded in 2013, Gate One incorporates 13 State-run ANSPs (Austria, Bosnia-Herzegovina, Bulgaria, the Czech Republic, Croatia, Poland, Lithuania, Hungary, Romania, Slovakia, Slovenia, Serbia/Montenegro and Macedonia), representing a continuous airspace region linking the Baltic Sea, the Balkans and the Black Sea (Air Traffic Management, 2013). Gate One

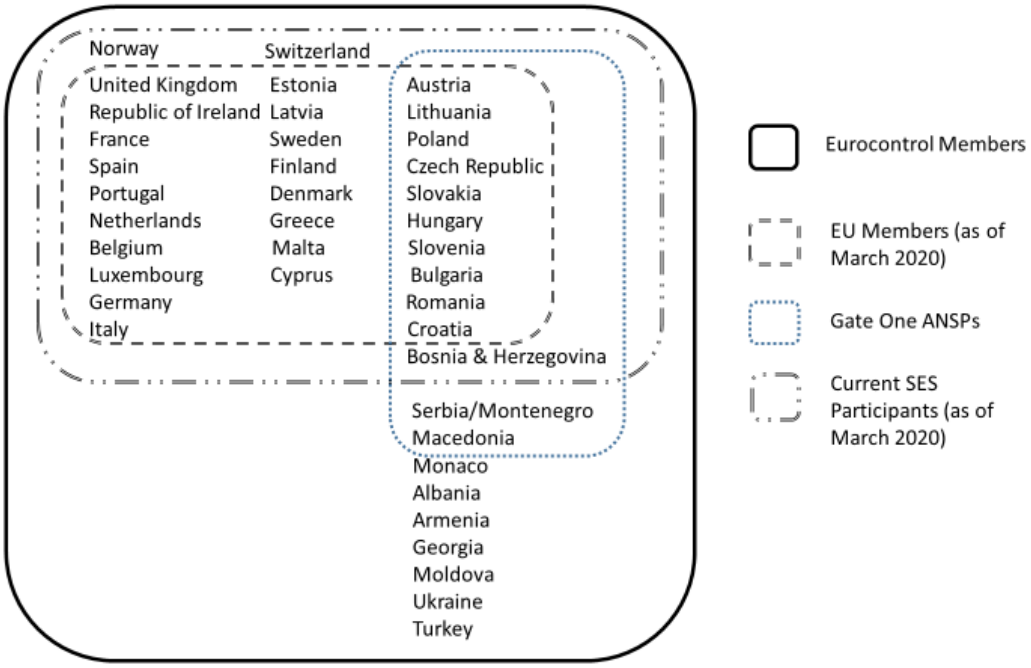

Figure 2. Venn Diagram displaying overlapping membership of European Organizations and ATM initiatives.

representatives have claimed that SES2+ is disproportionately framed in economic terms, while 'only marginally reflecting on the social, safety and environmental aspects thereof', and that the EC has 'completely failed to consider … regional specificities of ATM' (Fabrici, 2014). Gate One representatives have also expressed concern that its constituent ANSPs are not strong enough to compete in a fully liberalized market (Jelinek, 2014), and that there could be possible adverse consequences for jobs and professional livelihoods in their region. These representatives perceived further ATM liberalization as rendering Gate One ANSPs vulnerable to takeover by more powerful organizations based elsewhere around Europe.

SES2+ was viewed by EC respondents as a legislative exercise in 'clean-up' of existing regulations in which they perceived gaps (EC, 2016; EC FG, 2014). However, representatives of Gate One ANSPs claimed that SES2+ represents a significantly radical future for European ATM, and not simply a case of legislative 'fine tuning' (Jelinek, 2014). Such dissenting voices have claimed SES2+ proposes wholesale reforms to the FAB system, converting it into an 'industrial partnership' to function solely as a 'performance enabler', with little regard for the future of current ANSPs or jobs (Fabrici, 2014).

A number of respondents projected a more radical vision of European ATM if SES2+ were to be implemented. Such comments envisaged a future ATM environment with significantly fewer control centres distributed across Europe (ANSP interview, 2014; Eurocontrol interview, 2014; European ATM Meeting, 2014; EC FG, 2014). The privatization of ANSPs (which has occurred to various extents in some states) was regarded as a major avenue for change by some respondents. It was perceived that ANSPs could bid for services outside of their home territory (at least two ANSPs currently operate control towers in other European nations) (ANSP interview, 2014). The vision projected here is one which sees ANSPs, privatized and separated from the embrace of national governments, able to bid for services in ways transcendent of national borders. ANSPs could also operate as part of commercial consortia. Such large groupings were seen as potentially powerful actors who could control large areas of European airspace (ANSP interview, 2014; European ATM meeting, 2014).

This projected liberalized future suggested by some fieldwork data suggests one in which ANSPs, detached from national state control and operating as profit-making businesses, could freely buy and take over centres anywhere across Europe. Future technological improvements could also facilitate greater remote management of airspace. For example, it was envisaged that in such a scenario, ATCOs in Ireland could use remote technology to control Greek airspace (EC FG, 2014). Such an option could be advantageous in the event of a strike by ATCOs in one country. In this possible future, the intra- and inter-organizational constitutions of FABs could become highly fluid. FABs could contain within them privatized ANSPs. While one privatized ANSP could conceivably operate a single FAB, it is equally possible that multiple private ANSPs could co-operate to run a FAB as a joint venture.

This vision therefore foresees the potential for a host of differing and overlapping coalescences to emerge. The realization of such a vision could render the foundations and boundaries of ATM infrastructure highly fluid and dynamic.

Respondents from one ANSP that had undergone partial privatization expressed the view that SES2+ could threaten Eurocontrol's future. They suggested that their organization could, if SES2+ were to be passed, possibly bid for Eurocontrol's current Network Manager role:

> Some of the new [SES2+] proposals are that the Network Manager function doesn't necessarily have to be Eurocontrol anymore, our ANSP could bid for it and do it. Somebody else could bid for it and do it. So Eurocontrol are in this process of trying to find a role for themselves. (ANSP interview, 2014)

A Eurocontrol respondent saw the EU as driving the 'political vision' of SES (Eurocontrol interview, 2014). This vision entails a new political rationality co-evolving with technological innovation, although some perceived this as risking economic winners and losers, as exemplified by the concerns of the Gate One group. While some respondents saw Eurocontrol's future at risk from SES2+, the latter has sought to utilize its technical capital to promote innovation in ways which may allow the organization to retain an influential role in SES. The next section describes these developments.

Shaping a new role for Eurocontrol? 'Centralized Services'

Eurocontrol has proposed a series of measures through an initiative known as 'Centralized Services' (CS), aimed at reforming ATM information systems to assist national ANSPs to

meet targets set under the SES Performance Scheme. The primary driver for CS is to reduce costs by providing a range of services in which ANSPs would otherwise have to invest individually to keep pace with technological developments and challenges.

CS has thus been promoted as a means of easing the pressures exerted on ANSPs by the demands of the SES Performance Scheme, which obliges ANSPs to reduce costs while also upgrading systems:

> How can we deploy these things if some ANSPs say we don't have the funding, we don't have the money, or it would break our cost-efficiency targets, so how can they with this constraint? (Eurocontrol official at European ATM meeting, 2014)

CS was framed as a more fair alternative to other proposed efficiency measures that could, as one respondent suggested, potentially involve the reduction of ATCO staff or salaries. A reduction in ATCO staffing numbers was viewed as risky given the possibility of significantly increased traffic in the near future (Eurocontrol interview, 2014).

CS is intended to introduce a series of upgraded data and communications systems for ATM through a series of work packages. One such example is the proposed European Tracker Service, a short-term conflict alert system to identify aircraft flying too close to one another, which would link ATCOs and airports. Other CS systems are envisaged to link together radar systems and, in the future, satellite-based aircraft tracking systems.

CS has been portrayed as a logical extension of Eurocontrol's role in that many of its current functions are already centralized, such as route charges (Eurocontrol, 2013; European ATM meeting, 2014). A senior Eurocontrol official regarded some operational concepts of CS as up to twenty years old, but required a 'breakthrough in organizational developments' (Eurocontrol interview, 2014). According to this respondent, the trend toward liberalization gave various stakeholders the incentive to participate in the development of CS.

CS technology is intended to be produced through a process of tendered out-sourcing overseen by Eurocontrol. In 2014, it was claimed 300 organizations had expressed an interest in the CS tendering process (European ATM meeting, 2014). The first series of tenders for work packages were issued in 2014, with consortia of firms and organizations invited to bid for them. This study found that a large consortium of ANSPs was widely perceived as a potentially powerful actor who might make such bids. Discussions revealed a great deal of uncertainty concerning the potential susceptibility of the CS bidding system to such large consortia. At a meeting attended as part of this study, concerns remained about the relative vulnerability of certain ANSPs if CS were to go ahead. CS has faced scepticism from some national ANSPs, particularly those of smaller economies. During discussions in 2014, one ATCO representative from Cyprus expressed concerns that smaller ANSPs could be 'prey' to being taken over by conglomerates representing more powerful actors (European ATM meeting, 2014). Representatives of a larger ANSP also reported a sense of apprehension toward CS:

> Individual ANSPs are wary of this, as you might expect, and they're thinking 'well, we could do that why does it have to be Eurocontrol, and actually do we want to give up control of these services when we do it perfectly well?' (ANSP interview, 2014)

A discussion among European ATM stakeholders in 2014 raised other concerns about CS. One discussant opined that CS was simply a 'money-making exercise' (European ATM

meeting, 2014). A representative of an international ATCO trade union group criticized the potential ability of large consortia to bid for CS work packages, asking if this threatened to allow them to gain influence at the expense of Eurocontrol:

> Are you putting the jury in the seat of the judge? (Trade union official, European ATM meeting, 2014)

Similarly, representatives from one ANSP expressed concern that both CS and SES2+ could lead to more powerful actors monopolizing data and support services:

> In both the Centralized Services debate and the move to [SES2+] unbundling, there's a general feel from the trade unions that it could lead to new monopolies being created because you see that it could be a possibility. (ANSP interview, 2014)

Elsewhere, other trade union groups expressed the view that they hadn't been adequately informed about CS. One trade union representative also claimed that CS was not introducing any useful concepts or systems:

> Why invent the wheel when it has been working for 20 years? (European ATM meeting, 2014)

This study identified expressed concerns among ATCO discussants over the safety and security of data shared through CS. This type of data, seen as state information, was portrayed by one interlocutor as risking becoming private commercial property:

> CS might transfer public funds to industry. … I think that ultimately it's not about where data is processed. But who keeps and retains control over this data? Because if we centralize and give it to industry, we might actually put the core of our business in the hands of industry, which means that at one stage, we [ANSPs] might lose control, because they will control everything. And if we need access to this data, we will be totally dependent on a private company. And this is the fear. (European ATM meeting, 2014)

Hence, concerns also related to perceived risks of a creeping privatization, with states possibly relinquishing ownership of national ANSP data to organizations beyond their direct control. This was perceived as potentially impeding individual nations' agency to share data with specific actors as they are currently able.

Respondents from an ANSP claimed that CS represented an attempt on the part of Eurocontrol to maintain its status in the face of the increasing influence of EU/EC actors:

> Now the EC is taking more and more control, legislating, growing, there's this friction between EU/EC and Eurocontrol. So who gets to manage and own and run European airspace? Eurocontrol is having to redefine itself because it's got to find itself a new role, because it used to be the technical expertise, but now we have EASA. (ANSP interview, 2014)

Eurocontrol itself could face threats arising from CS. A Eurocontrol representative raised the possibility that some providers could collaborate independently of CS to offer a competing service:

> The situation is somewhat difficult – some key providers have made their own reflection – why don't we talk privately with other providers, why don't we go our own way regardless of CS? (Eurocontrol interview, 2014)

Major commercial companies were viewed as having the capacity to build systems that could compete with the CS vision:

> Industry, big companies – EADS, Thales – they say 'We have the know-how, we build our own system.' [Its] not the end of the story. (Eurocontrol interview, 2014)

Hence the promotion of CS has not come without a recognized degree of risk to Eurocontrol's own status.

If the CS vision were to be realized, Eurocontrol's role may evolve. CS entails the outsourcing of technology production to organizations that may be large ANSPs or private firms. In this way, the CS vision is commensurate with the EC's vision of fuller liberalization of ATM services. Through CS, Eurocontrol could nonetheless become a key hub for ATM liberalization and SES itself. However, realizing CS requires the input and co-operation of ANSPs, member states and commercial organizations. This does not appear to be guaranteed. ANSP representatives expressed concern over the potential risks to their status, and over data security and ownership rights. Some actors were viewed as becoming potential competitors to CS rather than stakeholders. CS also depends on acceptance from within the EU system, and on the recognition that CS could form part of the overall SES vision. Eurocontrol's agency within contemporary European ATM remains potentially subject to new threats, some of which may actually have arisen from its promotion of the CS concept.

In the concluding section of this article, I draw upon the empirical detail described in this paper to conceptualize the dynamics of the negotiation and projection of SES. These are framed as involving instances of perceived appropriation and emergent risks and uncertainties.

Conclusion

By providing a detailed overview of SES and its contested status, I have sought to explore the complex emergent claims to ATM that represent differing projected relations between national and transnational authority across European airspace. The earlier path of European ATM, presided over by Eurocontrol prior to the current EU system, can be characterized as an era of responsiveness to the technological challenges of jet travel. Eurocontrol, somewhat constrained by the wider political realities of the Cold War, nonetheless emerged as a key centre of technical expertise. The Eurocontrol system still embodies an intergovernmental approach that is largely focused on a relatively narrow technical agenda. Eurocontrol includes EU and non-EU states, and has ambitions to expand further.

While European ATM existed in a largely responsive mode to both technical changes and political crises during the 20th century, the evolution of the EU included a growing preoccupation with various aspects of aviation, and included the emergence of EASA. The 1999 EC communication, *The Creation of the Single European Sky*, represented a particularly significant intervention. This statement, which criticized Eurocontrol's intergovernmental approach, advocated a strategic supranational vision, framing ATM as embodying higher-

level goals of political union and market liberalization. SES has introduced a system of performance monitoring and efficiency, albeit one which is perceived to be somewhat removed from the ultimate vision of integrated airspace transcendent of national borders.

The EC and other EU bodies, Eurocontrol, nation states and organized labour continue to negotiate and contest SES. While the EC still relies greatly on Eurocontrol's intellectual and technical capital, the role and status of Eurocontrol in relation to the EC and other EU bodies such as EASA is still being shaped, with some tensions evident. A series of legislative proposals, from SES1 to SES2 and SES2+, have influenced interactions between stakeholders. These engagements reflected the interpretive flexibility of various SES initiatives, and involved reactions by some stakeholders to the perceived appropriation of ATM elements on the part of others, together with expressed concerns about possible risks and uncertainties arising from these initiatives.

These interactions centred on at least three issues. The first related to the SES Performance Scheme, which reflected a three-way space of contestation between transnational organizations, national governments, and organized labour. The EC has strongly criticized member states for their alleged reluctance to fully implement FABs, seen by some respondents as having been appropriated by the latter. States were also openly accused by a Eurocontrol official of manipulating the Performance Scheme by setting targets which did not reflect perceived realities. Trade union representatives accused states of appropriating the Performance Scheme to 'hide behind papers' and using it as an excuse to withhold benefits to ATCOs. Yet trade unionists also expressed resistance in the direction of the EC, arguing that the SES Performance Scheme has created significant uncertainties about possible trade-offs between efficiency and safety. This led to threats by international organized labour groups to take action.

A second issue concerned the SES2+ proposals to promote further ATM liberalization. These measures have been regarded as a means of reinvigorating SES and promoting cost-efficiencies. Some respondents described a possible future for European ATM, in which ANSPs may become fully privatized entities, detached from state control. These respondents envisaged that ANSPs could bid for and provide specific types of ATM services in different ways. Within such a vision, airspace over one European nation could conceivably be managed by various workers based considerable distances away. Through the potential unbundling of support services, European ATM could be rendered fluid and dissociable, producing an environment in which ATCOs, pilots and other workers might experience changing relations between distance and control. SES2+ appears to involve a notably indeterminate interpretation of what may constitute ATM 'support services'. This could enable new organizational, commercial and technological innovations to emerge. SES2+ proposals have, however, been resisted by some national ANSPs, notably the Gate One group, who have claimed such measures may capture functions which are currently state property. Trade union groups have also expressed concerns over who in the future might control European ATM, and the possible consequences for job security.

Debates around Eurocontrol's Centralized Services (CS) constituted a third notable issue. CS can be regarded as an imaginary for the future of Eurocontrol, nested within the broader SES vision. Some respondents claimed that CS reflected Eurocontrol's desire to maintain its status as a key informational conduit and centre of European ATM expertise. CS promises efficiencies for ANSPs commensurate with the SES Performance Scheme, but also reflects Eurocontrol's response to the contemporary culture of liberalization in European ATM. CS has however itself stimulated criticism from those it is ostensibly meant to assist, such as

smaller ANSPs who saw it as rendering them vulnerable to larger rivals, and also risking turning state information into a commercial commodity. A Eurocontrol representative even perceived CS to pose an existential threat to itself by opening up possible opportunities which commercial actors could appropriate at Eurocontrol's expense. The conditions of possibility for such risks to be perceived are at least partly shaped by the degree of proposed liberalization which has emerged in discussions over SES.

Eurocontrol's CS initiative nonetheless represents a vision distinct from that of the EC, reflecting a different balancing of liberalization versus state interests. The ultimate SES vision remains one in which airspace is ultimately decoupled from state control, re-organized on a route concentration basis and fully open to free-market liberalization, in line with higher-level EU political-economic values and goals to which member states, candidate and partner nations are expected to comply. While commensurate with such a vision, CS seemingly represents an attempt by Eurocontrol to maintain a degree of influence over the pace of reforms associated with SES. While CS still reflects a kind of technocratic commitment to the efficiency goals of the Performance Scheme, it adopts a more gradualist posture to airspace reform which, ostensibly at least, takes into account the sovereignty of its members and concerns about ATCO jobs and status.

Both the EC's and Eurocontrol's visions are susceptible to countervailing forces. The EC has had to contend with recalcitrant member states that are yet to fully embrace the SES vision. Meanwhile, Eurocontrol's CS concept is commensurate with EU values of liberalization, even though this has left CS open to criticisms, concerns and perceived threats.

At least three competing constructions of European airspace can thus be discerned from this study. The first reflects the current status quo, with airspace still significantly contiguous with existing sovereign boundaries, amid accusations by the EC and Eurocontrol that national governments have appropriated SES. The second, a competing vision of SES promoted by the EC, represents an ideal in which European airspace would be fully detached from national borders, and operated by liberalized entities to maximise efficiency of routing. This imaginary was perceived to be resisted by national governments and some ANSPs. Trade union groups have also opposed elements of this vision. The third construction reflects a vision promoted by Eurocontrol, where airspace may still be largely arranged around national borders, but with some cross-national technical functions delegated to Eurocontrol. While Eurocontrol has claimed to be acting in the interests of individual ANSPs, it has been perceived with suspicion by the latter and it remains uncertain whether the EC and EASA will accept these plans.

Differing projections of SES, and resistance toward these projections in the form of perceptions of actual or potential appropriation by others, articulate contested relations between state sovereignty and liberalizing European integration of ATM. They also articulate varying rationalities of territorial authority and control of information flows. These claims regarding European ATM reflected differing notions and views concerning where liberalization can and should go, coalesced with differing visions of how and where information should flow across space, and how those flows should be controlled and governed. These projections were found to be selective in terms of exactly what data and technology might remain as state property or become liberalized. The projected configurations of technology which emerged through these interactions shape differing orderings of state and transnational rationalities. By articulating various possible configurations of technology and its governance, these interactions mapped different

envisioned futures for European ATM, but perpetuated new rounds of controversy through opening up renewed areas of risk and uncertainty. At stake within these controversies were disputed interpretations of performance metrics, connected with disputes over how boundaries around European airspace should be drawn, and over who should control these territories and by what means. Some actors also perceived concerns about job security and safety to be at stake. These concerns and contestations were found to stem from tensions between different visions for the scope and pace of liberalization, future perceived relationships between national interests versus transnational ones, and differences over the future influence and role of various national and transnational actors.

Infrastructures configure actors and objects in assemblages (Birkenholtz, 2014; Bouzarovski et al., 2015) which may serve to constrain how those infrastructures are imagined (Smith and Tidwell, 2016). This article departs from many previous imaginaries studies in conceptualizing how actors engage with infrastructural plans and visions. The focus on SES draws renewed attention to the ways in which actors already configured in and materially constrained by the functioning of infrastructural systems are compelled to engage with visions for the future. While engaging with imaginaries, actors may not necessarily perceive them in exclusively positive terms, and may perceive aspects of sociotechnical imaginaries in a negative or risky light (Jasanoff and Kim, 2009). Here it is significant how stakeholders, bound to collectively invest in the imaginary of SES, were found to be suspicious of others, seeing elements of SES as vulnerable to appropriation and exploitation. Negotiating the SES imaginary has entailed a politics of suspicion and risk which reflects a certain instantiation of interpretive flexibility. While risk perceptions extended to concerns over trade-offs between safety and efficiency, other concerns notably involved stakeholders imagining how others perceived the SES imaginary. It is tentatively suggested here that the term ‘imaginative flexibility’ better captures the latter phenomenon.

While some expressions of resistance came from the bottom up in the form of trade union criticisms of national governments and their ANSPs, the EC and Eurocontrol have also been constrained among a series of interdependences and tensions. National ANSPs still have to work within the Eurocontrol framework and with elements of the EC/EU system such as EASA. The EC has, however, struggled to compel members to fully invest in the ultimate vision of SES. While tensions are apparent between Eurocontrol and the EC/EU, the organizations depend on each other for technical and political support. In contrast to previous imaginaries studies, which have portrayed them as reflecting the exercise of power and/or resistance in relatively monodirectional ways, here the existence of multiple overlapping transnational organizations, in addition to intra- and international tensions, have rendered power structures more complex and multi-directional. The interdependencies at play in the case of SES suggest that researchers should continue to problematize relationships between those who participate in and construct sociotechnical imaginaries. Rather than restricting analyses of European imaginaries to describing their making and unmaking in certain spaces (Mager, 2017), it is important to go further and to consider the interrelations, perceptions and manoeuvres between and across groups and the projected assemblages which both emerge from and shape these interactions. Future research could address other examples of international ATM projects in regions such as Asia (Jeziorski, 2012). Rather than groups being engaged in straightforward contests for dominant imaginaries, SES suggests a more complex picture in which participants engaged in the construction of imaginaries are involved in the kind of coordination problems and risk calculations not unfamiliar to political science. This article suggests that a future research agenda could work toward identifying points of potential synergies between STS and political theory more broadly construed.

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