The European Air Navigation Services Industry: a Market Analysis

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Abstract

In Europe, air navigation services (ANS) are more expensive compared to other regions. More input factors are used, while less flights are handled. Traffic is expected to continue to grow, putting pressure on the current European model for ANS provision. To develop a model for the future, a profound understanding of the ANS market is needed. This paper identifies the market structure, its players and their relationships through a review of existing scientific literature as well as available reports published by air navigation service providers (ANSPs) and ANS regulators. The main findings are that European ANSPs have established a geographical monopoly mainly due to legally set up entry barriers and perceived economies of scale. This leads to a situation in which market power towards airspace users remains relatively high despite recent policy efforts. However, possibilities to open up the ANS market can be identified, but require further research.

1 Introduction

Air navigation service providers (ANSPs) are an important part of the air transport value chain. They provide services that enable the safe conduct of flight. Earlier research demonstrates that air navigation services (ANS) are more expensive in Europe compared to other geographical regions, using more input factors while handling less flights (EUROCONTROL and FAA, 2016). The main challenge faced by the European Commission and the European ANSPs is how to create a system for ANS that is capable of establishing an optimal operational and cost efficient performance in a business environment in which air traffic movements are continuously growing. Answering this question requires a profound knowledge of the European ANS market.

Section two of this paper provides some background on ANS and ANSPs. The third section uses the market structure part of the structure-conduct-performance (SCP) paradigm. This paradigm will be applied in later research to explain links between the ANS market structure and the ANSP conduct and performance. At this stage of the research it just provides inspiration to construct the analysis. A fourth and last section borrows concepts from strategic analysis to describe the relationships between the main players active in the ANS market.

2 Air navigation services

ANS are the specific types of services provided to airspace users (AUs) during all phases of operations as well as the equipment or tools used in providing these services. Five types of ANS are provided:

1. Air traffic management (ATM) (including airspace management, air traffic flow management (ATFM) and air traffic services (ATS));

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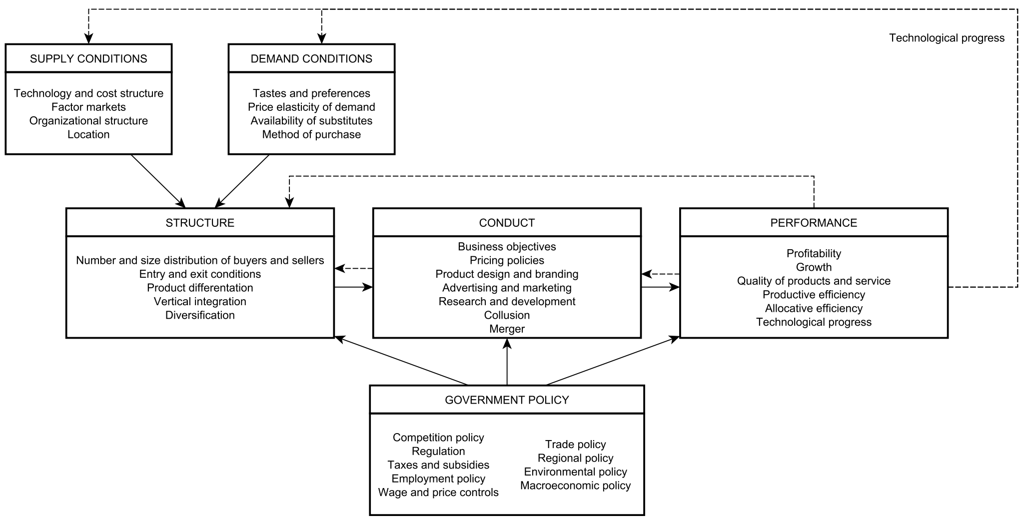
Figure 1: Structure-conduct-performance (SCP) paradigm



Source: taken from Lipczynski et al. (2005)

2. Communication, navigation and surveillance systems (CNS);

3. Meteorological services for air navigation (MET);

4. Search and rescue services (SAR); and

5. Aeronautical information services (AIS).

(EUROCONTROL, 2016a)

Tomová (2015) makes a distinction between core and non-core or support ANS. Core ANS are the services linked to ATM, while CNS, MET and AIS can be considered as non-core services, supporting ATM.

In addition to ANS, ANSPs often offer non-aeronautical commercial services such as consulting, training and R&D services.

For the purpose of this research an ANSP is defined as an organization offering at least terminal and/or en-route air traffic services to airspace users.

The focus of the research is on the European ANS market, with *European* referring to the European common aviation area (ECAA)[1] including Switzerland.

3 ANS market structure

Different approaches are used in scientific literature to analyse strategic behaviour of organizations. Among the most popular models are the SCP paradigm and Porter's five forces model the most interesting to inspire a market analysis. Both have a market structure component influencing organizational behaviour and performance. The main difference between the two is that Porter's model takes a strategic management viewpoint in which the organization is the central object, while the SCP paradigm takes an industrial economic viewpoint focusing on the context of competitive behaviour (Ormanidhi and Stringa, 2008). Since this paper is part of a broader research project which aims at explaining strategi-

[1] The European common aviation area consists of the EU member states, Albania, Bosnia and Herzegovina, Bulgaria, Croatia, FYR of Macedonia, Iceland, Montenegro, Norway, Romania, Serbia and Kosovo.

cal choices from the industrial context, an industrial economic viewpoint is chosen here. The analysis of the ANS market structure will therefore be based on a modernized version of the SCP paradigm as presented by Lipczynski et al. (2005) and shown here in figure 1. This model basically assumes that the structure of a market influences the conduct of the organizations operating in this market, which in turn has an influence on organizational performance. However the influences also work in the opposite direction. Identifying those links — in figure 1 represented by arrows — for the European ANS industry will eventually assist ANSPs and regulators to define a strategy to address todays challenges.

Lipczynski et al. (2005) identify five main characteristics of a market structure as part of the SCP paradigm: the number and size distribution of buyers and sellers; entry and exit conditions; product differentiation; vertical integration; and diversification. Each of them will be analysed separately for the European ANS market.

3.1 Number and size distribution of buyers and sellers

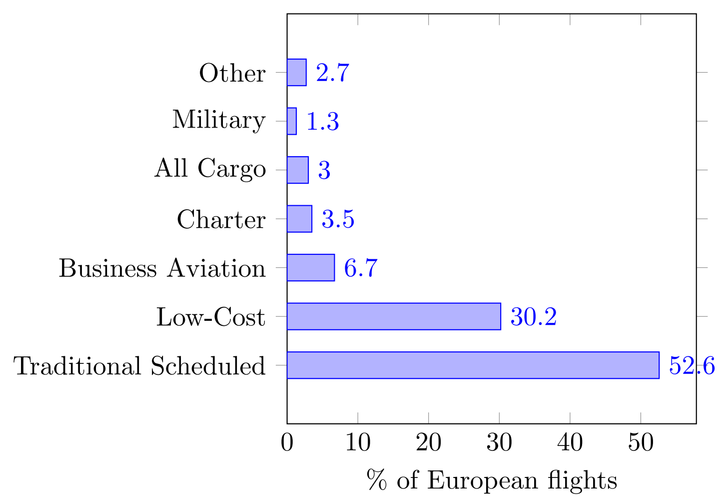
In Europe there are around forty active ANSPs which are strongly geographically distributed. Each airspace sector is served by only one service provider, which gives ANSPs a geographical monopoly. Table 1 provides a notion of the size of the national ANSPs active in Europe. DFS[2] (Germany), DHMI[3] (Turkey), DSNA[4] (France), ENAIRE (Spain), ENAV (Italy) and NATS[5] (UK) are significantly larger in size than the other national ANSPs. The size of the ANSP is mostly determined by the characteristics of the geographical market in which it is active. The German ANSP DFS for instance is larger in size than Belgian Belgocontrol since the former controls a larger airspace. (EUROCONTROL, 2016b,c)

The AUs (airlines, military and general aviation) are large in number and heterogeneous in size. The size and importance of an AU to an ANSP seems to depend on:

1. the home market of the AU; and
2. the market segment to which it belongs.

An AU with its home market located in the airspace sector controlled by the ANSP will more frequently buy services from this ANSP compared to an AU whose home market is located elsewhere. Figure 2 presents the contribution of different AU-types to the European ANSP customer base. The traditional scheduled airlines constitute the largest customer segment with a 52.60% total share, followed by low-cost carriers with a total of 30.20%. It is presumable that the more the AU contributes to the customer base of an ANSP, the larger its buyer power will be.

Figure 2: Breakdown of European flights by market segment: Jan-Nov 2016



Source: own composition based on EUROCONTROL (2016e)

[2]Deutsche Flugsicherung

[3]Devlet Hava Meydanlar İşletmesi

[4]Direction des Services de la Navigation Aérienne

[5]National Air Traffic Services

Table 1: Descriptive statistics of national ANSPs in the European common aviation area (2014)

ANSP	**Country**	**Total staff**	**Size of controlled airspace (km^2)**	**Total IFR flights controlled**
Albcontrol	Albania	327	36 000	198 399
ANA	Luxembourg	180	n.a.	84 222
ANS CR	Czech Republic	880	76 100	682 563
ASHNA	Kosovo	n.a.	n.a.	n.a.
Austro Control	Austria	858	79 500	903 549
Avinor	Norway	986	724 000	621 113
Belgocontrol	Belgium	767	39 500	563 112
BHANSA	Bosnia Herzegovina	450	n.a.	n.a.
BULATSA	Bulgaria	1101	145 000	683 320
Croatia Control	Croatia	704	158 000	520 874
DCAC Cyprus	Cyprus	197	174 000	304 325
DFS	Germany	5465	390 000	2 772 617
DHMI	Turkey	5883	982 000	1 235 140
DSNA	France	7746	1 010 000	2 845 477
EANS	Estonia	163	77 400	190 501
ENAIRE	Spain	3682	2 190 000	1 681 498
ENAV	Italy	3086	733 000	1 550 608
Finavia	Finland	377	411 000	229 263
HCAA	Greece	1660	538 000	677 777
HungaroControl	Hungary	725	104 000	717 157
IAA	Ireland	430	481 000	536 948
Isavia	Iceland	225	n.a.	130 856
LFV	Sweden	1005	626 000	682 995
LGS	Latvia	363	95 200	240 571
LPS SR	Slovak Republic	474	48 700	435 890
LVNL	Netherlands	898	53 000	567 805
MATS	Malta	150	231 000	101 906
M-NAV	FYR of Macedonia	271	24 700	146 380
NATS	UK	4069	870 000	2 214 690
Nav Portugal	Portugal	704	671 000	479 220
Naviair	Denmark	618	158 000	632 309
Oro Navigacija	Lithuania	291	74600	224 039
PANSA	Poland	1739	334 000	690 554
ROMATSA	Romania	1544	254 000	598 230
Skyguide	Switzerland	1347	69 700	1 164 916
Slovenia Control	Slovenia	217	20 400	273 748
SMATSA	Serbia & Montenegro	856	128 000	551 569

Source: own composition based on EUROCONTROL (2016b, pp. 149-155); ANA (2015); European Commission (2017); Isavia (2015); CANSO (2017)

3.2 Entry and exit conditions

3.2.1 Economies of scale

Because of the high capital cost of infrastructure needed for ANS provision, logical thinking suggests that economies of scale should exist to some extent. The findings of Button and Neiva (2014); Adler et al. (2014) indeed suggest the existence of scale economies quantitatively, however they are unable to say whether these economies of scale stem from economies of density or scope. Nevertheless, ANSPs are generally seen as being natural monopolists (Sclar, 2003), meaning that their minimum efficient scale is larger than current market output. The results of Bilotkach et al. (2015) indicate that for the period 2002-2004 most European ANSPs took advantage of scale economies, especially for Western European ANSPs.

If economies of scale exist in the ANS market as suggested by the literature, then this existence can be considered as one of the main entry barriers. An ANSP entering a new geographical market needs to make large investments in new local infrastructure. However, if the entrant manages to buy existing infrastructure as a service from another provider, this barrier can easily be overcome. Since most ANS infrastructure in Europe is owned by the national ANSPs they might be reluctant to make it available for the use of others to defend their market power. Some sort of policy measure can be taken here to increase market competition.

Economies of scale do not necessarily have to exist to the same extent for the whole package of services offered by ANSPs. For some ANS, entry barriers might be lower than for others. Providing air traffic management requires different investments than e.g. providing aeronautical information services.

3.2.2 Absolute cost advantage

The absolute cost advantages that the national ANSPs might have over new entrants seem to be small. There is no superior production process that would be difficult to copy, no exclusive ownership over factor inputs (although attracting air traffic controllers from the incumbent or training new ones might be costly) and no cheaper access to financial sources than a new entrant would have. Nevertheless, because the national ANSPs are strongly diversified and partly vertically integrated (see section 3.4) they might have developed an absolute cost advantage over new entrants coming from economies of scope, yet the existence of such economies is not proven.

National ANSPs might also have cost disadvantages. Besides the high infrastructure cost, the ANS industry is still quite labour intensive. Staff costs account for 52% to 69% of total ATM/CNS provision costs of the five largest European ANSPs (EUROCONTROL, 2016b). Most national ANSPs have a long history and background as a division of a government department. Nowadays most of them are commercialized but part of their history might still be institutionalized in their cost structure. Since new entrants do not have such history they might be able to achieve a cost advantage by acquiring lower priced labour and infrastructure.

3.2.3 Natural product differentiation

It would be difficult for a new entrant to differentiate its service from the national ANSP since the core ANS products are in essence identical. The only possibility to differentiate would be price differentiation as AUs tend to opt for the lowest price if both services are equal. Natural product differentiation is therefore not an entry barrier.

3.2.4 Legal barriers

Legal barriers are present in the form of certification requirements. According to the basic regulation and its European implementing regulation laying down the common requirements for the provision of ANS, ANSPs need to acquire a certificate from the national supervisory authority in the state of principal operation before they are allowed to provide ANS. The compliance to the conditions of the certificate is monitored annually. (European Commission, 2011)

In theory every organization can operate as an ANSP if it can demonstrate it complies with all requirements. In reality, ANSPs have obtained legal monopoly rights. The national ANSPs usually have the exclusive right to provide en-route services in their home country. Therefore, competition *in* the market is limited. Competition *for* the market however is increasing as European countries are liberalizing their ANS markets, especially for terminal services. In certain countries, ANSPs can bid for a licence to provide terminal services at given airports. The competition is in the bidding for the licence. Once an ANSP has obtained the licence, it has its legal geographical monopoly right for a certain time period. Examples of this competition *for* the market can be found in Germany, Spain, Sweden and the UK.

3.3 Product differentiation

Core ANS are in essence always identical, which makes product differentiation difficult. Differentiation in core services is therefore often based on airspace user charges which are regulated by the European Common Charging Scheme (European Commission, 2013). Because of the geographic monopoly position of the ANSP, AUs flying through a specific airspace sector cannot choose their supplier. However, they can choose in which airspace sectors they fly or at least to some extent. Research done by Delgado (2015) produces evidence that airlines face a trade-off between the length of the route (influence on fuel costs and schedule) and airspace user charges. Depending on the business model of the airline, they will prefer one alternative above the other. An ANSP offering services at lower user charges will be considered as more attractive. However as Delgado (2015) demonstrates, only 6.4% of flights included in his study actually choose the longer flight to save on airspace user charges. The opportunity to do so exists only in certain parts of Europe making competition based on price differentiation rather limited.

For non-core ANS and non-aeronautical commercial services offered by ANSPs the possibilities for product differentiation are broader. Non-core ANS still have to comply with the quality and safety requirements prescribed by European legislation, however rules are less strict. Slight differences in quality are acceptable which opens the door to more competition. Unbundling of non-core from core ANS might be a way to go to allow more players into the market.

Since ANS are organized geographically in the current market structure, ANS are always geographically differentiated. Each ANSP only offers ANS in one particular geographical area making ANS provided by another ANSP useless inside these airspace sectors. As discussed by Delhaye and Blondiau (2016) the regulator could decide to organize ANS based on routes instead of based on flight sectors. Route based ANS would put an end to structural geographical differentiation since the AU would then be able to buy services for the entire flight from one service provider. An ANSP would then lose its legal geographical monopoly and directly compete with other providers on the entire European territory. Beside the potential benefits, the discussions of Delhaye and Blondiau (2016) with ANS stakeholders indicate that such a radical reform is currently difficult to organize practically.

3.4 Diversification and vertical integration

The European ANS market is dominated by the traditional national ANSPs. With the exception of DCAC Cyprus[6] (Cyprus), DSNA (France) and HCAA[7] (Greece) which are still part of a government department, all European ANSPs are commercialized state-owned organizations. Only NATS (UK) and to a limited extend Skyguide (Switzerland) have private share capital. These national European ANSPs are quite diversificated offering multiple ANS as well as other non-aeronautical commercial services such as consulting, training and R&D services. They usually offer aeronautical information services, air traffic services (both terminal as en-route) and communication, navigation and surveillance systems. Although being an ANS, SAR services are rarely offered by European ANSPs. The European Commission does not mention SAR in their definition of ANS (European Commission, 2004, p. 6). This service is usually pro-

[6]Department of Civil Aviation of Cyprus
[7]Hellenic Civil Aviation Authority

vided by a government department part of the Ministry of Defence, Transport or Justice. Only in Austria, Bosnia and Herzegovina, Bulgaria, Czech Republic, Finland, Ireland, Romania, Slovak Republic and Slovenia the provision of SAR is delegated to the national ANSP. It can therefore be concluded that SAR services are still seen as a government service in most European countries. In addition, MET services are in 17 out of 36 ECAA countries still regarded as a government service and are solely provided by a national meteorological institute. In Hungary and Latvia MET services are provided by both the ANSP as the national meteorological institute and in Malta the service is provided by the meteo office of the airport operator. (EUROCONTROL, 2016c)

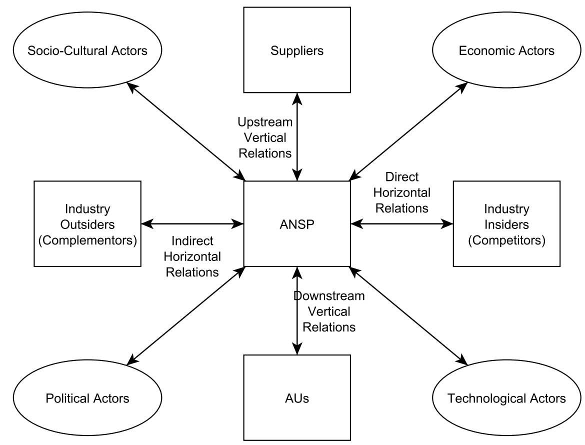
As a result of this diversification, European ANSPs are partly vertically integrated. Most traditional ANSPs develop their own ATM systems and provide in-house training for their air traffic controllers (ATCOs). However, there is a visible trend towards more outsourcing of this kind of activities. Some ANSPs are collaborating and setting up subsidiaries for training and R&D to save on costs and to bring these services to market (see Sections 4.3.1 and 4.3.2 for examples).

Next to the traditional operators there are also other players active on the market, being either fully third party players or subsidiaries of traditional ANSPs. These non-traditional players only provide terminal ANS (mostly ATS) and are less diversified. At some airport the airport operator functions as the terminal ANSP.

4 Relationships between ANS market players

The relationships between the key actors in the ANS market could be analysed by applying a model described by de Wit and Meyer (2005), which is presented in figure 3. This model makes a distinction between industry and contextual actors and is based on stakeholder theory. The industry actors are those directly related to the value-added activities of the ANSP, while the contextual actors intentionally or

Figure 3: The ANSP and its web of relational actors



Source: own composition based on de Wit and Meyer (2005)

unintentionally influence the conditions under which the ANSP has to operate. This section of the paper mainly focusses on the industry actors in which four main types of relationships can be identified: upstream (supplier) relations, downstream (buyer or AU) relations, direct and indirect horizontal relations. The model of de Wit and Meyer (2005) is chosen because it draws attention to strategic interorganizational relationships and it is directly applicable to the ANS-context.

4.1 Upstream (supplier) relations

The suppliers of ANSPs are basically suppliers of Flight Data Processing systems as well as of technical CNS equipment used in service provision (e.g. surveillance radar). There are around ten such suppliers active in Europe (eg. Indra, Thales, Raytheon). Because of the structure of the ANS market, the suppliers of such technology face a limited number of clients to sell their products to. This is why suppliers often work in close collaboration with the ANSPs to develop a tailor-made system adapted to their needs. This strategy allows the supplier to bound with a given number of ANSPs. (Baumgartner and Finger, 2014)

The close cooperation between the ANSPs and their suppliers has both advantages as disadvantages. The disadvantage is that the ANSP becomes dependent on one supplier since products of competitors are often not interchangeable with their existent systems. This might result in a lower buyer power for the ANSP because they cannot fully use the threat of switching to another supplier during contract negotiations as in other industries. On the other hand, the close cooperation enables the ANSP to embed its knowledge of its operating environment into the custom made system, which might lead to a better and more efficient service provision in the longer run. Other disadvantages are the high development costs and the fact that each ANSP has a unique custom-made system which makes collaboration between ANSPs more difficult. Even between control centres of the same ANSP differences in systems might occur.

4.2 Downstream (AU) relations

The principal clients of ANSPs are the airspace users (AUs). Both are highly dependent on each other. For the ANSPs on which data is available, the largest customer has a share in the total customer base[8] between 10 and 17%. One can expect the largest customer to be the former national carrier. However, this does not have to be the case. For example in Estonia and Lithuania the largest customer is Finnair, in Italy and Spain the largest customer is Ryanair.

Past research (depending on the source) indicates that ANS charges represent between 5 and 9% of total airline operating costs, with the share being influenced by the airlines' business model[9] (Adler et al., 2014; Castelli and Ranieri, 2007). Not only cost-wise, but also in terms of operational performance airlines depend on ANSPs. If ANSPs are not performing according to the best practice, airlines will not be able to be as performant as they wish to be (Andrew, 2012).

[8]Expressed in total revenue.

[9]Note that this percentages depend on the fluctuation of oil prices.

This should give airlines an incentive to use their buyer power towards the ANSPs. However, previous evidence indicates that AUs have rather limited abilities to influence ANSP strategic decisions. The possibilities for switching to other providers are restricted by the structure of the market and airlines often face larger incentives to reduce fuel costs. An airlines investments in ANSP consultation processes is additionally to the benefit of other airspace users (possible competitors) who are not willing to make this kind of investment. This makes it difficult for an airline to counter the market power of the ANSP. (Arblaster, 2012; Blondiau et al., 2015)

Since the commercialization wave during which the organizational structure of ANSPs changed from a government department to an independent organization, regulators and ANSPs are working to improve the ANSP-AU relations. In Europe NATS (UK) is still the only ANSP with AUs acting as a shareholder, while also LVNL[10] (Netherlands) has direct airline representatives in its advisory board (EUROCONTROL, 2016b). McDougall and Roberts (2007) argue that direct user representation in the board might lead to conflicts of interest. They claim that airlines prioritize cost control and fee reduction while ANSPs have other concerns. In one case this lead to an increase in safety infractions. They find however that ANSPs allowing customer involvement in their management decision-making are best performing.

European regulation obliges ANSPs to organize regular formal consultation rounds with AUs at least once a year (European Commission, 2011). There is a visible trend in the market towards more informal cooperation between the national ANSP, the airport operator and the home carrier. An example of this is the Airport Collaborative Decision Making (A-CDM) at several airports in Europe. In A-CDM the airport operator, airlines, ground handlers and the ANSP share real-time operational information to enable better predictability of processes and to improve operational efficiency.

[10]Luchtverkeersleiding Nederland

4.3 Direct horizontal relations

Direct horizontal relations are the strategic relationships between ANSPs. Different kinds of relations can be observed in the European ANS industry: strategic alliances (see table 2), joint-ventures for supporting services and functional airspace blocks (FABs), a form of structural collaboration induced by the European Commission's Single European Sky (SES) initiative. Each of these relational forms will be analysed in more detail.

4.3.1 Alliances

One of the first alliances that was established in the European ANS industry is the MET Alliance in 2005. The MET Alliance unites eight national aeronautical meteorological service providers. They share expertise to better incorporate MET services with ATM and they work together operationally by sharing tools and resources as well as collaborating on cross-border forecasts. Next to the three ANSPs mentioned in table 2 the members consist of Deutcher Wetterdienst (Germany), MET Éireann (Ireland), MeteoSwiss (Switzerland), KNMI (Netherlands) and Météo France (France). (MET Alliance, 2015)

Later, in April 2006, the COOPANS Alliance was founded. The aim of its founding members was to have a common ATM system that is continuously improved and updated and to share the costs of its development. This is opposed to most other European ANSPs who have their own legacy systems and use large planned one-time system improvements. The alliance partners chose Thales as the preferred technology supplier. Because of the success of the shared ATM system, the alliance members later decided to jointly participate in Single European Sky ATM Research (SESAR) projects. (COOPANS, 2016)

Because of the success of COOPANS other operational alliances followed. Older political cooperations such as the Nordic cooperation which has been in place for more than fifty years reinvented themselves (NEAP, 2008). In 2007, the Irish Aviation Authority joined the Nordic cooperation and the name changed to North European Air navigation service Providers (NEAP). Since then, the aim was no longer just to represent the members at ICAO, but to achieve more international cooperation on the operational level. (NEAP, 2008)

Other consortia were established with the aim to participate in SESAR projects: North European and Austrian consortium (NORACON) a collaboration between the Swedish airport operator Swedavia and eight European ANSPs; and in 2011 the A6 Alliance which tries to bring together all ANSPs involved in SESAR (see table 2). The A6 Alliance members handle more than 80% of European air traffic. Their aim is to seek for synergies between the ANSP members within SESAR and to deliver customer and network benefits. (A6 Alliance, 2016; NORACON, 2010)

Also, the Borealis Alliance established in July 2012 is a combination of a lobby and operational alliance. Their objective is twofold: create value for customers by facilitating cooperation between members and to lobby for members in the regulatory and policy bodies in Europe. (Borealis, 2016) The alliance will set out projects to achieve operational or financial efficiencies through joint activities. The alliance has its own customer charter that explains how the alliance handles customer relationships. Important to notice is that the alliance aims to seek for economies of scale to the benefit of its customers. Borealis projects include the establishment of a free route airspace, improved datalink services and joint AIS for the benefit of customers. (Borealis, 2014, 2016)

4.3.2 Joint-ventures

ANSPs have established joint-ventures for training their air traffic controllers and for the joint development of new technology, as well as the exploitation of these technologies. The main goal for engaging in such joint-ventures are cost savings and commercialization of innovations. Examples of such collaborations include Group EAD (an aeronautical data management company operating on behalf of EUROCONTROL), ESSP (the European Satellite Services Provider owned by seven European ANSPs operating a satellite based system for navigation. ESSP has a pan-European certificate to act as an actual ANSP.), Aireon (a company setting up a system for space based surveillance) and Entry Point North (an ANS

Table 2: ANSP alliances

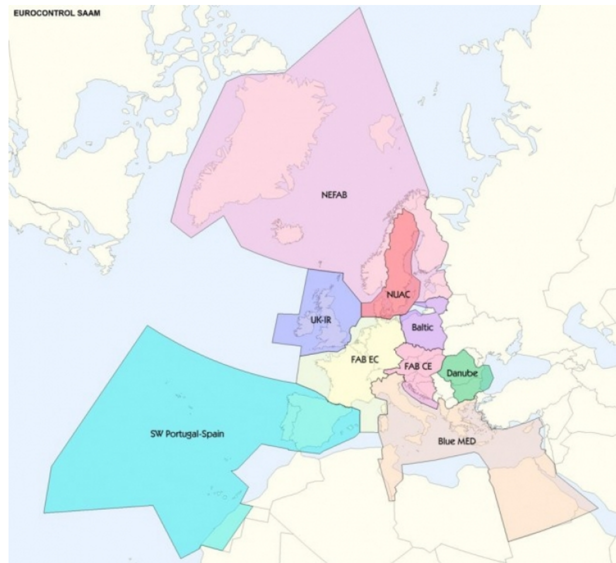
ANSP	**Country**	**MET**	**COOPANS**	**NEAP**	**NORACON**	**B4**	**A6**	**Borealis**
ANA	Luxembourg	x						
ANS CR	Czech Republic					x	x	
Austro Control	Austria	x	x		x		x	
Avinor	Norway			x	x		x	x
Belgocontrol	Belgium	x						
Croatia Control	Croatia		x				x	
DFS	Germany						x	
DSNA	France						x	
EANS	Estonia			x	x		x	x
ENAIRE	Spain						x	
ENAV	Italy						x	
Finavia	Finland			x	x		x	x
IAA	Ireland		x	x	x		x	x
Isavia	Iceland			x	x		x	x
LFV	Sweden		x	x	x		x	x
LGS	Latvia			x	x		x	x
LPS SR	Slovak Republic					x	x	
NATS	UK			x	x		x	x
Naviair	Denmark		x	x	x		x	x
Oro Navigacija	Lithuania					x	x	
PANSA	Poland					x	x	

Source: based on A6 Alliance (2016); Borealis (2016); COOPANS (2016); MET Alliance (2015); NEAP (2008); NORACON (2010); SESAR Joint Undertaking (2017) training company jointly operated by four ANSPs). Since a technology supplier is participating in both Group EAD (Frequentis) and Aireon (Iridium) these joint-ventures are not pure forms of a direct horizontal relation, but could also be classified as upstream supplier relations. However the difference here is that more than one ANSPs is involved.

4.3.3 Functional airspace blocks

As part of the SES initiative of the EU, the European airspace is divided into nine FABs as can be seen from Figure 4. The goal of the establishment of these FABs is to optimise ANS provision regardless of state boundaries by enhancing cooperation between ANSPs. The ultimate aim as mentioned in the SES framework regulation is to, where appropriate, eventually have one integrated ANSP for a FAB (European Commission, 2004). Until now, different attempts to integrate the ANSPs have been made, but only two examples of FAB-wide ANSPs can be found: Maastricht Upper Area Control (MUAC) and Nordic Unified Air Traffic Control (NUAC).(EUROCONTROL, 2016d)

Figure 4: European FABs



Source: EUROCONTROL (2011)

Maastricht Upper Area Control The foundations for the MUAC and indirectly also for SES were established in 1952. The development of the jet engine made the existing air route network insufficient. The airspace was fragmented into small flight sectors, each managed by an air traffic controller. The jet engine increased aircraft cruising speeds leading to inefficiencies in air traffic control (ATC). Pilots continuously had to change radio frequencies and recontact ATC when crossing a sector border. Air traffic controllers saw aircraft entering and leaving their sector, without any time to intervene. This lead to the idea of creating an upper air route network above the existing one, adapted to the needs of the jet age. The only problem was that back in 1950s the upper airspace was entirely at the disposal of military traffic, leading to the need for more cooperation between civil and military authorities. In 1952 Belgium, Germany, Luxembourg and the Netherlands agreed to study the advantages of the creation of a common international air traffic centre to manage their upper airspace. These four countries can be seen as the founding fathers of EUROCONTROL. In 1960, Belgium, France, Germany, Luxembourg, the Netherlands and the United Kingdom signed a convention that established EUROCONTROL. The initial plan was to divide the upper airspace into four upper information regions controlled from four control centres: Benelux/Germany, France, UK London and UK Preston. In 1964 the decision was taken to set up the first EUROCONTROL international upper area control centre in Maastricht. In 1970 and 1971 two other upper area control centres were approved: in Karlsruhe (Germany) and in Shannon (Ireland). MUAC became operational in 1972 and initially controlled the upper airspace of Belgium and Luxembourg. Later the Hannover Upper Information Region and the Amsterdam Flight Information Region were added. Shannon and Karlsruhe became operational in 1975 and 1977 respectively, but became part of their respective national ANSP thereafter. Today MUAC controls 260,000 km^2 of upper airspace which is used by 70% of European airspace users on a regular basis. (EUROCONTROL, 2012, 2016f; McInally, 2010; Neiva, 2015)

Nordic Unified Air Traffic Control NUAC was established in 2009 by Naviair and LFV to operate as a subcontractor on behalf of its two shareholders. NUAC is the ANSP providing en-route services in the Danish - Swedish FAB and therefore the school example of what the SES initiative wants to achieve. Naviair and LFV provide NUAC with employees and equipment. (Naviair, 2016)

The difference between MUAC and NUAC is that the first one is nothing more than a control centre operated by EUROCONTROL on behalf of Benelux countries and Germany, while NUAC is a separate joint-venture like ANSP.

4.4 Indirect horizontal relations

Some ANSPs engage in formal indirect horizontal relations with universities for research purposes. Examples include Tern Systems (a joint-venture between Isavia and the University of Iceland for the development of ANS technology) and CRIDA (a collaboration between ENAIRE and the Polytechnic University of Madrid for R&D in ATM. The existence of informal relations between ANSPs and academic research institutes are unknown since they are not reported.

5 Conclusion

The European Commission and the European ANSPs are faced with the challenge to modernize the European model for ANS provision in a changing business environment. To develop a model for the future, a profound understanding of the ANS market is needed. This paper identified the market structure, its players and their relationships through a review of existing scientific literature as well as available reports published by ANSPs and ANS regulators.

The ANS market is characterized by a large number of buyers, the airspace users, which come in different types and sizes. The most significant users of ANS are the traditional and low cost airlines which together account for over 80% of traffic in Europe. These airspace users buy services from around 40 European ANSPs which have established a geographical monopoly over their home markets. These monopolies are maintained via legally set up entry barriers and perceived economies of scale. However more research is required to assess whether European ANSPs are operating at their minimum efficient scale or not. The possibility exists that European ANSP need to consolidate to increase geographical market and reach their optimal size. Recent attempts by European states to liberalize their local market only introduced competition for the market in the form of bidding for a temporary licence granting the exclusive right to operate. Competition in the market remains limited.

The European ANSPs, from which most are commercialized state-owned organizations, are very diversified. Different types of ANS as well as non-aeronautical commercial services are offered by the national ANSPs. Most ANSPs used to develop part of their ATM systems and also train their air traffic controllers in-house. However, today these operations are often outsourced to joint-ventures which on top provide these services to third parties. These non-core and non-aeronautical services leave margin for differentiation as long as the delivered services comply with basic quality and safety requirements. Differentiation based on quality of service might contribute to a better value proposition for the customer, and eventually a more competitive business model. More research to the extent in which ANSPs differ in quality of service is needed to assess whether this might be a base for future competition. Differentiation of core ANS is often based on price, since the core services are more strictly regulated and in essence always identical.

The technology used by ANSPs is supplied by 10 different organizations. Because the market of these suppliers is very limited, they collaborated with the ANSPs in the past to develop unique tailor-made systems making the ANSPs highly dependent on their supplier. Nevertheless, ANSPs seem to have some market power over the airspace users. The AUs are operationally dependent on the ANSPs and, because of the market structure, have limited or no possibilities to switch to alternative providers. In spite of the market power imbalance, there is a visible trend of more cooperation between ANSPs, local airport operators and the home carrier.

European ANSPs are working more closely together. Proof of this can be found in the large amount of alliances that exist today (see table 2). The alliances seem to have evolved from lobbying groups via operational collaboration to, at least on paper, more customer centric alliances. The focus is shifting from knowledge and technology cost sharing to cooperation for customer value creation. Besides alliances, ANSPs have established joint-ventures with other ANSPs and technology suppliers for the commercialization of innovations and air traffic control training activities. The attempt of the European Commission to initiate more integration between ANSPs via the creation of FABs generated little success as today only two integrated ANSPs exist in Europe (MUAC and NUAC).

The ANS industry is putting its customers more central and is developing in a direction of even more collaboration. In order to face the challenge of modernizing the European ANS industry there is still a long way to go. More research will be required into how ANSP business models can evolve especially with regard to the existence of economies of scale and scope, optimal organization size, service quality and the customer value proposition.

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