

REPORT COMMISSIONED BY THE PERFORMANCE REVIEW COMMISSION

ATM Cost-Effectiveness (ACE) 2016 Benchmarking Report with 2017-2021 outlook

**Prepared by the Performance Review Unit (PRU)
with the ACE Working Group**

May 2018

BACKGROUND

This report has been commissioned by the Performance Review Commission (PRC).

The PRC was established in 1998 by the Permanent Commission of EUROCONTROL, in accordance with the ECAC Institutional Strategy (1997).

One objective in this Strategy is *«to introduce strong, transparent and independent performance review and target setting to facilitate more effective management of the European ATM system, encourage mutual accountability for system performance and provide a better basis for investment analyses and, with reference to existing practice, provide guidelines to States on economic regulation to assist them in carrying out their responsibilities.»*

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NOTICE

The Performance Review Unit (PRU) has made every effort to ensure that the information and analysis contained in this document are as accurate and complete as possible. Should you find any errors or inconsistencies we would be grateful if you could please bring them to the PRU's attention.

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DOCUMENT IDENTIFICATION SHEET

DOCUMENT DESCRIPTION

Document Title

ATM Cost-Effectiveness (ACE) 2016 Benchmarking Report with 2017-2021 outlook

DOCUMENT REFERENCE

ACE 2016

EDITION:

Final report

EDITION DATE:

May 2018

Abstract

This report is the sixteenth in a series of annual reports based on mandatory information disclosure provided by 38 Air Navigation Services Providers (ANSPs) to the EUROCONTROL Performance Review Commission (PRC). This report comprises factual data and analysis on cost-effectiveness and productivity for 38 ANSPs for the year 2016, including high level trend analysis for the years 2011-2016. The scope of the report is both en-route and terminal navigation services (i.e. gate-to-gate). The main focus is on the ATM/CNS provision costs as these costs are under the direct control and responsibility of the ANSP. Costs borne by airspace users for less than optimal quality of service are also considered. The report describes a performance framework for the analysis of cost-effectiveness. The framework highlights 3 key performance drivers contributing to cost-effectiveness (productivity, employment costs and support costs). The report also analyses forward-looking information for the years 2017-2019, inferring on future financial cost-effectiveness performance at system level, and displays information on actual and planned capital expenditures for the period 2011-2021.

Keywords

EUROCONTROL Performance Review Commission – Economic information disclosure – Benchmarking – Exogenous factors – ATM/CNS cost-effectiveness comparisons – European Air Navigation Services Providers (ANSPs) – Functional Airspace Blocks (FABs) – Gate-to-gate - En-route and Terminal ANS – Inputs and outputs metrics – Performance framework – Quality of service – 2016 data – Factual analysis – Historic trend analysis – Costs drivers – Productivity – Employment costs – Support costs – Area Control Centres (ACCs) productivity comparisons – Current and future capital expenditures – ATM systems – Forward-looking trend analysis (2017-2019) – Planned capital expenditures (2017-2021).

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DOCUMENT INFORMATION

TYPE		STATUS		DISTRIBUTION	
Performance Review Report	<input type="checkbox"/>	Draft	<input type="checkbox"/>	General Public	<input checked="" type="checkbox"/>
Report commissioned by the PRC	<input checked="" type="checkbox"/>	Proposed Issue	<input type="checkbox"/>	EUROCONTROL Organisation	<input type="checkbox"/>
PRU Technical Note	<input type="checkbox"/>	Released Issue	<input checked="" type="checkbox"/>	Restricted	<input type="checkbox"/>

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READER'S GUIDE

This table indicates which chapters of the report are likely to be of most interest to particular readers and stakeholders.	
Executive summary	All stakeholders with an interest in ATM who want to know what this report is about, or want an overview of the main findings.
Chapter 1: Introduction	Those wanting a short overview of the structure of the report, the list of participating ANSPs, and the process to analyse the data comprised in this report.
Part I: Pan-European system cost-effectiveness performance in 2016 and outlook for 2017-2019	
Chapter 2: Pan-European system cost-effectiveness performance in 2016 with 2017-2019 outlook	<p>All those who are interested in a high level analysis of economic and financial cost-effectiveness performance in 2016 at Pan-European system and ANSP level. This chapter also includes a medium-term trend analysis of ATM/CNS cost-effectiveness performance over the 2011-2016 period, and an analysis focusing on its three main economic drivers (productivity, employment costs and support costs).</p> <p>Chapter 2 also comprises a forward-looking analysis of ATM/CNS performance over the 2017-2019 period, including capital investment projections. Chapter 2 provides a factual analysis which is stable over time and allow for monitoring cost-effectiveness performance achievements.</p> <p>This chapter is particularly relevant to ANSPs' management, policy makers, regulators and NSAs in order to identify best practices, areas for improvement, and to understand how cost-effectiveness performance has evolved over time. This information is also useful to support consultation processes between ANSPs and airspace users.</p>
Chapter 3: ANSPs balance-sheet structure and capital expenditures	<p>All those who are interested in a high level analysis of ANSPs assets and liabilities structure. This chapter also includes a medium term analysis of ANSPs capex over the 2011-2016 period with a specific focus on investments linked to ATM systems.</p> <p>This chapter is particularly relevant to ANSPs' management, airspace users, regulators and NSAs in order to get high level information on ANSPs historic and planned capital investments.</p>
Part II: Cost-effectiveness performance focus at ANSP level (2011-2021)	
Chapter 4: Focus on ANSPs individual cost-effectiveness performance	<p>All those who are interested in obtaining an independent and comparable analysis of individual ANSP historic performance (2011-2016) in terms of economic and financial cost-effectiveness.</p> <p>This chapter is particularly relevant to ANSPs' management, airspace users, regulators and NSAs in order to identify how cost-effectiveness performance has evolved and which have been the sources of improvement. This chapter also includes information on ANSPs historic and planned capital investments (2011-2021), as well as a benchmarking analysis of financial cost-effectiveness with a set of comparators for each ANSP. This information is also useful to support consultation processes between ANSPs and airspace users.</p>
Annexes:	<p>With a view to increase transparency, this report comprises several annexes including the data used in the report.</p> <p>This information is relevant to support cost-benefit analysis of ATM research projects like the SESAR programme. The data comprised in these annexes is also useful to academic researchers for the purposes of empirical analysis.</p>

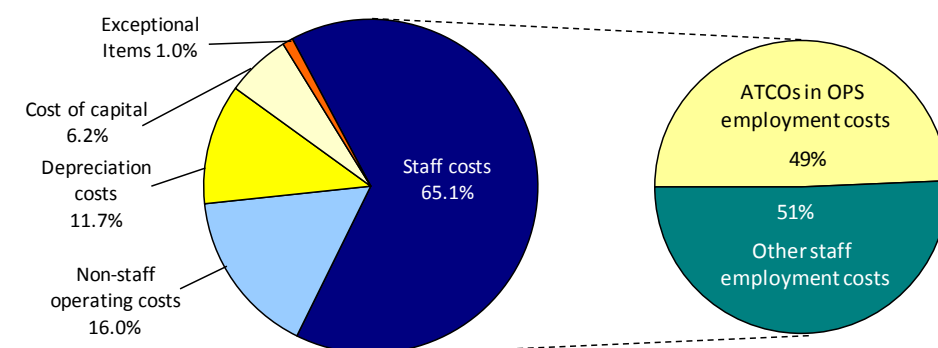
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EXECUTIVE SUMMARY

This ATM Cost-Effectiveness (ACE) 2016 Benchmarking Report, the sixteenth in the series, presents a review and comparison of ATM cost-effectiveness for 38 Air Navigation Service Providers (ANSPs) in Europe. The ACE benchmarking work is carried out by the Performance Review Commission (PRC) supported by the Performance Review Unit (PRU) and is based on information provided by ANSPs in compliance with Decision No. 88 of the Permanent Commission of EUROCONTROL on economic information disclosure.

The data processing, analysis and reporting were conducted with the assistance of the ACE Working Group, which comprises representatives from participating ANSPs, airspace users, regulatory authorities and the Performance Review Unit (PRU). This enabled participants to share experiences and gain a common understanding of underlying assumptions and limitations of the data.

The Pan-European system analysed in this report comprises ANSPs, National Supervisory Authorities (NSAs) and other regulatory and national authorities, national MET providers and the EUROCONTROL Agency. **From a methodological point of view, the ACE Benchmarking analysis focuses on the specific costs of providing gate-to-gate ATM/CNS services which amounted to €8 092M in 2016.** Operating costs (including staff costs, non-staff operating costs and exceptional cost items) accounted for some 82% of total ATM/CNS provision costs, and capital-related costs (depreciation and cost of capital) represented some 18%.



Total ATM/CNS provision costs: € 8 092 M

	En-route		Terminal		Gate-to-gate	
	€ M	%	€ M	%	€ M	%
Staff costs	4 075	64.2%	1 191	68.0%	5 265	65.1%
ATCOs in OPS employment costs	2 000	n/appl	597	n/appl	2 597	n/appl
Other staff employment costs	2 075	n/appl	593	n/appl	2 668	n/appl
Non-staff operating costs	1 003	15.8%	294	16.8%	1 297	16.0%
Depreciation costs	784	12.4%	159	9.1%	943	11.7%
Cost of capital	416	6.6%	89	5.1%	504	6.2%
Exceptional Items	65	1.0%	17	1.0%	82	1.0%
Total ATM/CNS provision costs	6 342	100.0%	1 750	100.0%	8 092	100.0%

Figure 0.1: Breakdown of ATM/CNS provision costs in 2016

ACE 2016 presents information on performance indicators relating to the benchmarking of cost-effectiveness and productivity performance for the year 2016, and shows how these indicators changed over time (2011-2016). It examines both individual ANSPs and the Pan-European ATM/CNS system as a whole. In addition, ACE 2016 analyses forward-looking information covering the 2017-2019 period based on data provided by ANSPs in November 2017.

The ACE factual and independent benchmarking provides a detailed benchmarking of cost-effectiveness performance at ANSP level including a trend analysis of three main economic drivers (productivity, employment costs and support costs) over the 2011-2016 period.

Although benchmarking cost-effectiveness is key, looking at costs in isolation of the quality of service is not sufficient. The PRC introduced in its ACE Benchmarking Reports the concept of economic cost-effectiveness indicator in order to better capture the trade-offs between ATC capacity and costs.

This indicator is defined as gate-to-gate ATM/CNS provision costs plus the costs of ATFM delays for both en-route and terminal ANS, all expressed per composite flight-hour.

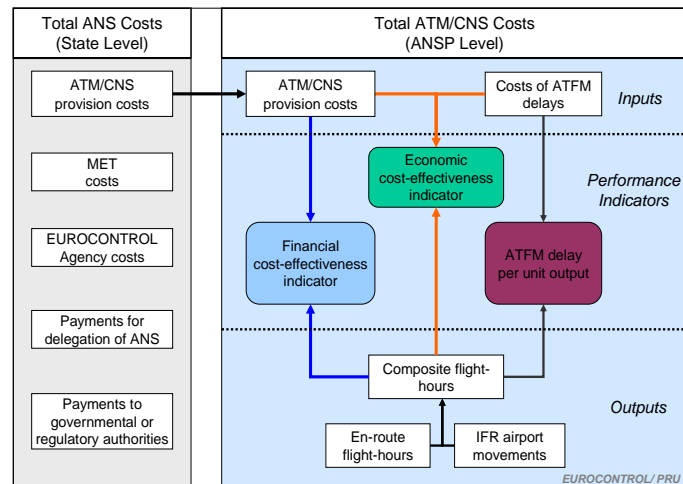


Figure 0.2: Conceptual framework for analysis of ATM/CNS cost-effectiveness

This economic performance indicator is meant to capture trade-offs between ATC capacity and costs. **The analysis of economic cost-effectiveness performance in 2016, the last year of available ACE data, shows that composite flight-hours rose by +2.4% while ATM/CNS provision costs slightly increased (+0.6% in real terms). As a result, unit ATM/CNS provision costs reduced by -1.7% in 2016. Since the unit costs of ATFM delays increased (+7.5%), unit economic costs decreased by -0.4% compared to 2015.**

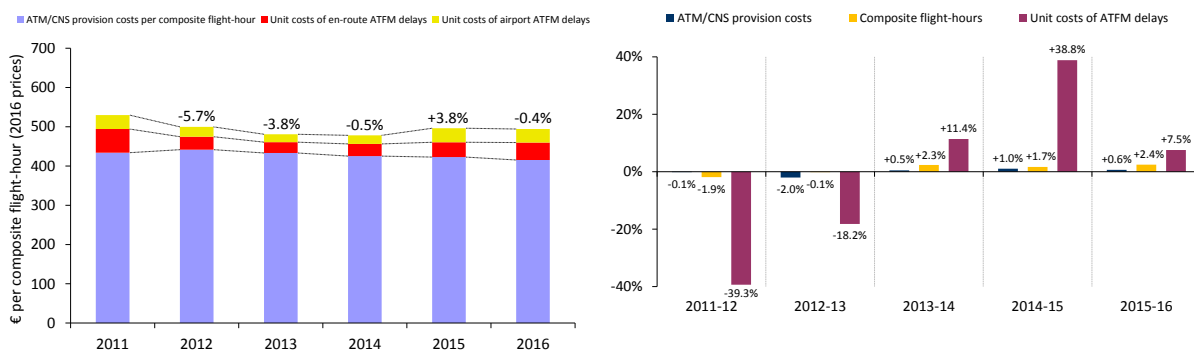


Figure 0.3: Changes in unit economic costs, 2011-2016 (real terms)

It is important to note that the change in the unit costs of ATFM delays (+7.5%) is affected by the use of a new methodology by the EUROCONTROL Network Manager to calculate delays since April 2016. The main objective of this new methodology is to address an issue relating to the use of the Ready Message (REA), whilst attempting to improve punctuality for aircraft, could result in artificial changes to the computed ATFM delay for individual flights and for the ANSP that has requested the regulation.

The implementation of the new calculation methodology affects the comparison of the economic cost-effectiveness indicator between 2015 and 2016. Indeed, 2015 ATFM delays were calculated according to the old methodology while 2016 ATFM delays were computed using the new methodology. When both 2015 and 2016 ATFM delays are computed according to the old methodology, the unit costs of gate-to-gate ATFM delays rose by +20.3% in 2016 and unit economic costs were +1.5% higher than in 2015. This adjustment is shown in Figure 0.4 below.

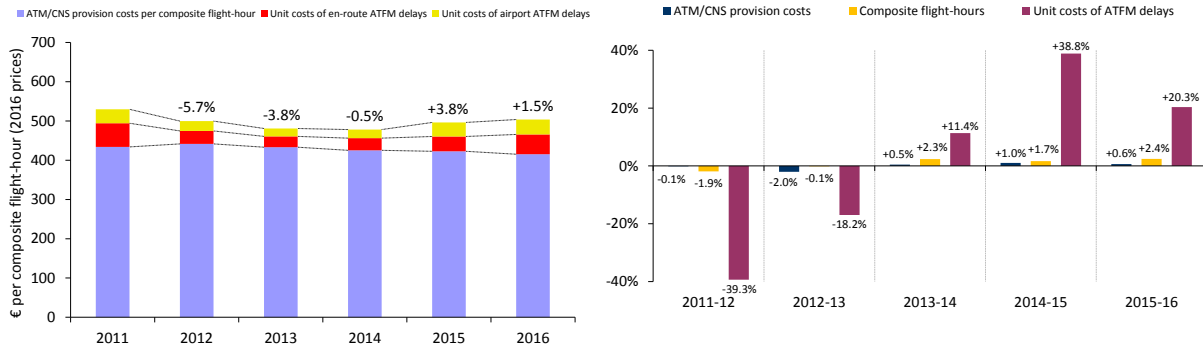


Figure 0.4: Adjusted changes in unit economic costs, 2011-2016 (real terms)

Further details on the new methodology used by the Network Manager to compute ATFM delays from 2016 onwards are available in Part I of this report.

The trend of decreasing ATFM delays which began in 2011 stopped in 2014, when a new cycle characterised by higher delays started: +14.0% in 2014, +41.1% in 2015 and +23.3% in 2016.

Recent analyses indicate that this increasing trend continued in 2017 albeit in a lower magnitude since en-route ATFM delays were +7.1% higher than in 2016.

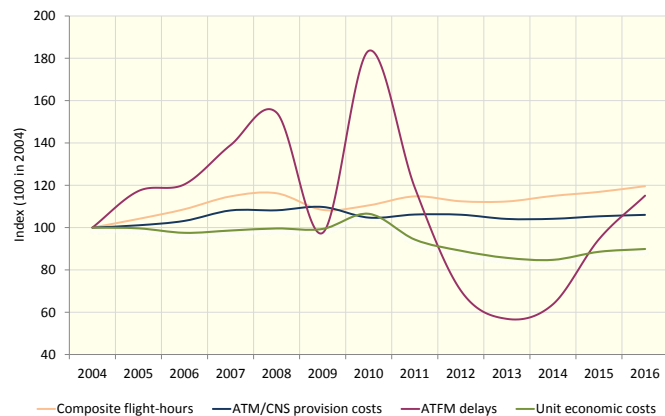


Figure 0.5: Long-term trends in traffic, ATM/CNS provision costs and ATFM delays

Figure 0.6 below provides a detailed analysis of the changes in cost-effectiveness at ANSP level between 2015 and 2016, identifying the cost and the traffic effects. It shows that **in 2016, ATM/CNS provision costs decreased for 19 out of 38 ANSPs** (see bottom quadrants of Figure 0.6). For seven ANSPs, the decrease in ATM/CNS provision costs was achieved in a context of traffic reduction (see bottom-left quadrant).

For UKSATSE, traffic significantly fell for the third year in a row (-10.4% in 2016 following -36.1% in 2015 and -36.7% in 2014).

These sharp traffic reductions mainly reflect the establishment of restricted/prohibited areas in UKSATSE airspace following the accident of Malaysia Airlines flight MH17 and military conflicts in the Eastern region of Ukraine and the fact that Russian airlines are not allowed anymore to operate to/from Ukrainian airports and to overfly the Ukrainian airspace since the last quarter of 2015.

It is noteworthy that in 2016, ATM/CNS provision costs rose by more than +10.0% for three ANSPs: MoldATSA (+13.5%), DHMI (+11.5%) and ROMATSA (+10.3%). The main drivers for these significant increases are provided in Part I of this report.

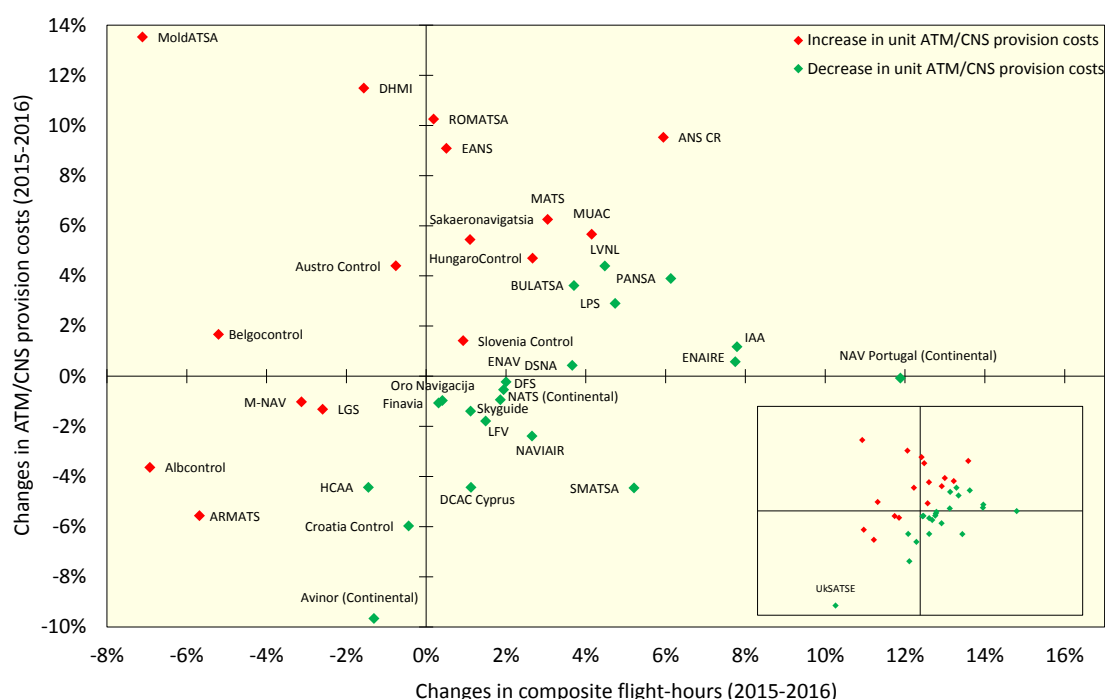


Figure 0.6: Changes in ATM/CNS provision costs and traffic volumes, 2015-2016 (real terms)

Around 30% of ATM/CNS provision costs directly relates to ATCOs in OPS employment costs while some 70% relate to “support” functions including non-ATCOs in OPS employment costs, non-staff operating costs and capital-related costs such as depreciation costs and the cost of capital.

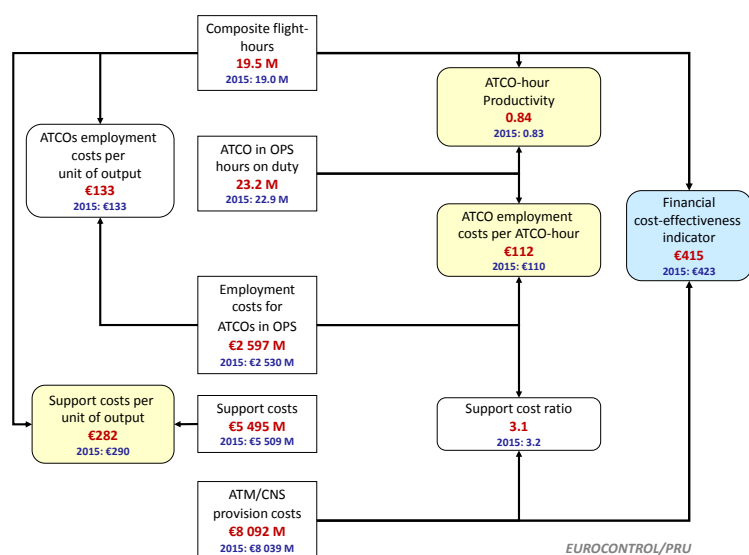


Figure 0.7: ACE performance framework, 2016

At Pan-European system level, unit ATM/CNS provision costs amounted to €415 in 2016.

According to the ACE performance framework, this cost-effectiveness performance indicator can be broken down into three main components:

- ATCO-hour productivity (0.84 composite flight-hours per ATCO-hour);
- ATCO employment costs per ATCO-hour (€112); and,
- support costs per unit output (€282).

In 2016, ATCO employment costs per ATCO-hour (+1.4%) and ATCO-hour productivity (+1.2%) rose at a relatively similar pace. As a result, ATCO employment costs per composite flight-hour remained fairly constant (+0.2%). In the meantime, unit support costs fell by -2.6% since support costs remained relatively stable (-0.3%) while the number of composite flight-hours increased (+2.4%). As a result, in 2016 unit ATM/CNS provision costs reduced by -1.7% at Pan-European system level.

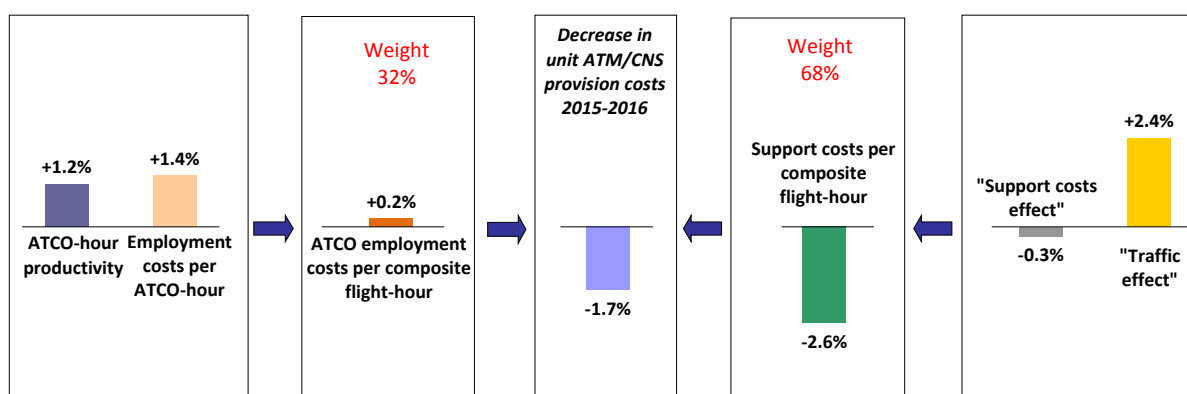


Figure 0.8: Changes in the financial cost-effectiveness indicator, 2015-2016 (real terms)

The ACE 2016 Benchmarking Report also analyses indicators derived from ANSP balance-sheets and capital expenditures.

The total Net Book Value (NBV) of fixed assets used by the Pan-European ANSPs to provide ATM/CNS services is valued at some €7.3 Billion, which means that overall €0.8 of fixed assets are required to generate €1 of revenue, an indication of relative capital intensity (this ratio is about 2 for airlines and about 3 for main airports operators).

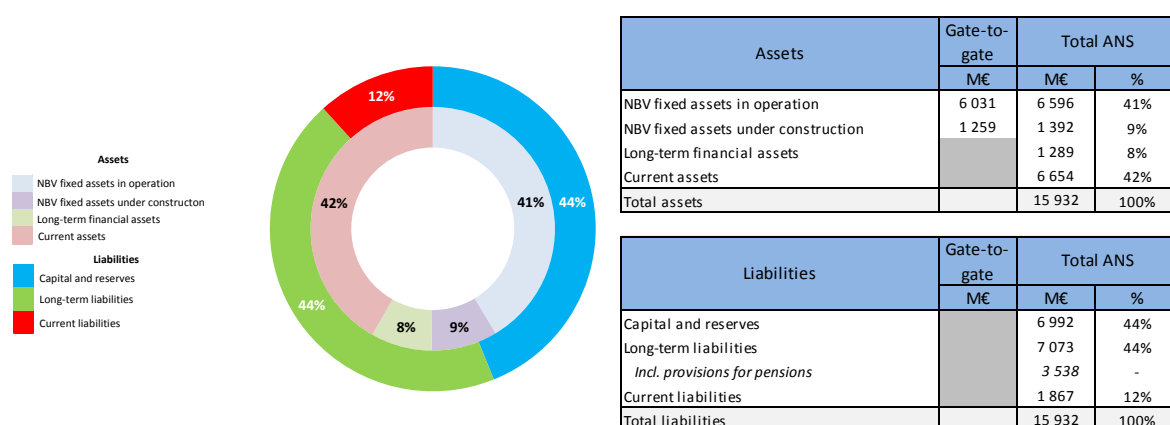


Figure 0.9: ANSPs assets and liabilities structure, 2016

In 2016, half of the total value of ANSPs' assets was linked to fixed assets, whether in operation (41%) or under construction (9%). The remaining half related to current assets, amounting to 42% of the total, and long-term financial assets (8%).

The liability side of the ANSPs' balance-sheet comprises capital and reserves, which represented 44% of the total value of the liabilities while long-term liabilities and current liabilities amounted to 44% and 12%, respectively. The main component of the long-term liabilities is relating to provisions for pensions which represented 22.2% of ANSPs total liabilities in 2016.

In 2016, the total ANSP capex at Pan-European system level amounted to some €1.1 Billion.

During the five-year period 2011-2016, ANSPs invested a cumulative amount of €6.2 Billion (around €1.0 Billion p.a.) with different investment cycles and magnitudes across ANSPs. Average ANSPs “capex to revenue” ratios – a measure of the magnitude of the investment cycle for each ANSP – over the 2011-2016 period are shown in Figure 0.10.

For four ANSPs, the “capex to revenue” ratio is higher than 20% indicating substantial investments on the period.

High level information on the main ATM software for the Flight Data Processing (FDP) and Radar Data Processing (RDP) is also analysed in this ACE 2016 Benchmarking Report.

Figure 0.11 provides information on the suppliers of the different FDP systems that are operated across Europe. The fact that a relatively large number of manufacturers compete should contribute to reduce the price of FDP systems. On the other hand, additional costs may arise from the duplication of FDP systems specification, customisation and maintenance, which are typical elements of support costs.

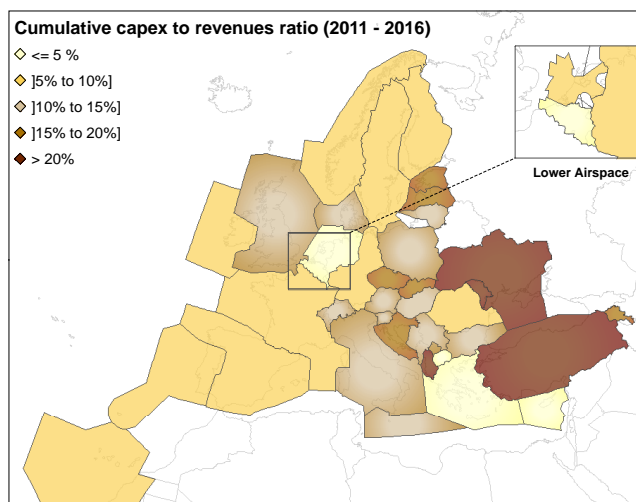


Figure 0.10: ANSPs cumulative capex to revenues ratio (2011-2016)

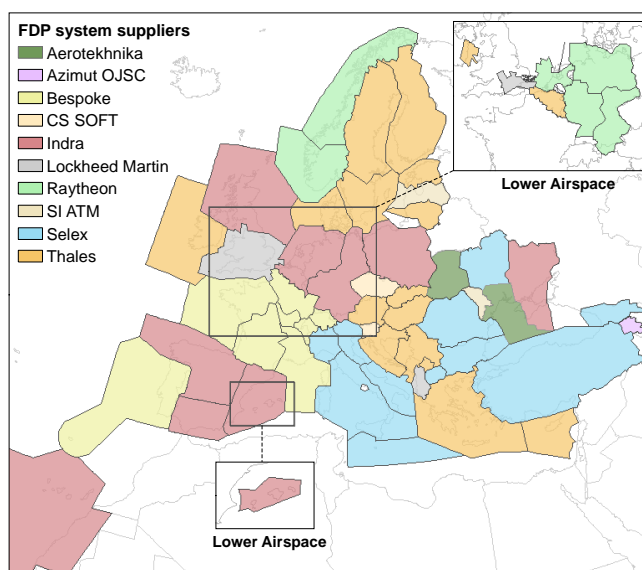


Figure 0.11: FDP systems suppliers, 2016

Similarly, the fact that neighbouring ANSPs operate non interoperable FDP systems might contribute to create additional ATCO workload associated with the interface between the different systems.

Some ANSPs have established partnerships for the common procurement and/or development of ATM systems. COOPANS which was initiated by IAA, LFV and NAVIAIR also involves Austro Control and Croatia Control. Another partnership is COFLIGHT, involving DSN, ENAV and Skyguide. Finally, the iTEC consortium involves Avinor, ENAIRE, DFS, LVNL, NATS, Oro Navigacija and PANSA.

Further initiatives towards achieving a higher level of shared infrastructure and/or interoperable systems are encouraged. The bulk of investment being related to software, there should be a high potential for reducing procurement, development and maintenance costs if ATM systems are jointly developed as part of common initiatives. Similarly, a higher level of interoperability between FDP systems (regardless of whether they have been supplied by the same company or not) should bring operational benefits to ANSPs.

At Pan-European system level, after decreasing by -1.7% in 2016, gate-to-gate unit ATM/CNS provision costs are expected to slightly increase in 2017 (+0.9%) and then to fall by -2.1% p.a. until 2019.

Overall, gate-to-gate unit ATM/CNS provision costs are expected to fall by -1.1% p.a. between 2016 and 2019. This mainly reflects the fact that over this period traffic is planned to increase faster (+3.6% p.a.) than ATM/CNS provision costs (+2.4% p.a.).

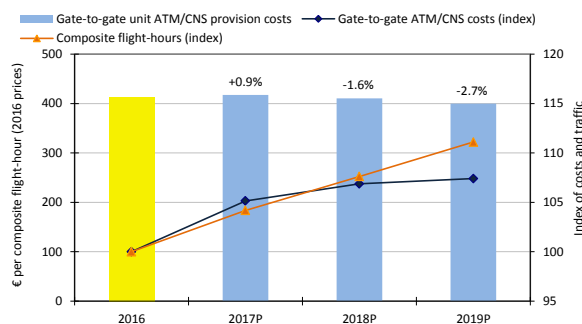


Figure 0.12: Forward-looking cost-effectiveness (2016-2019, real terms)

All categories of costs are planned to rise over the 2016-2019 period, with significant increases foreseen for non-staff operating costs (+3.8% p.a.) and capital-related costs (+5.4% p.a. and +2.6% p.a. for the depreciation costs and the cost of capital, respectively).

The cumulative capex planned for the period 2017-2019 amounts to some €3 635M or an average of €1 212M per year.

Figure 0.13 shows that the average capex to depreciation ratio planned over 2017-2019 (1.33) is significantly higher than that observed over the 2011-2016 period (1.12). This indicates that, overall, ANSPs asset bases are expected to grow faster than in the past six years.

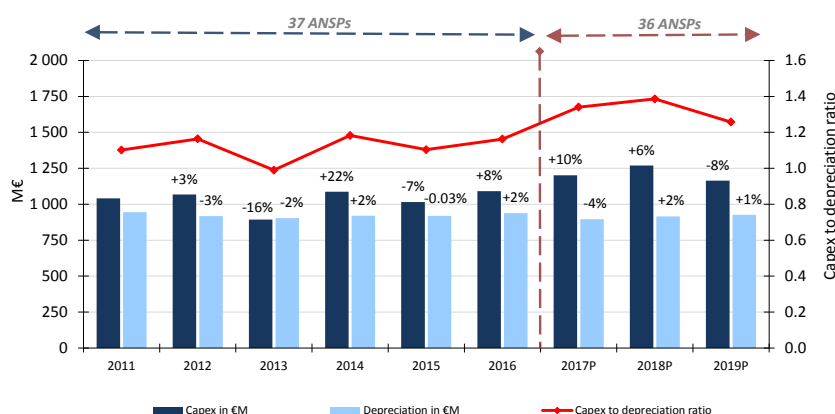


Figure 0.13: Capital expenditures and depreciation costs (2011-2019, real terms)

Additional information on the nature and magnitude of the major investment projects for each ANSP is provided in Part II of this Report.

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1 INTRODUCTION

The Air Traffic Management Cost-Effectiveness (ACE) 2016 Benchmarking Report commissioned by EUROCONTROL's independent Performance Review Commission (PRC) is the sixteenth in a series of reports comparing the ATM cost-effectiveness of EUROCONTROL Member States' Air Navigation Service Providers (ANSPs)¹.

The report is based on information provided by ANSPs in compliance with Decision No. 88 of the Permanent Commission of EUROCONTROL, which makes annual disclosure of ANS information mandatory, according to the Specification for Economic Information Disclosure² (SEID), in all EUROCONTROL Member States.

This report does not address performance relating to:

- oceanic ANS;
- services provided to military operational air traffic (OAT); or,
- airport (landside) management operations.

The analysis developed in the ACE Reports is particularly relevant in order to identify best practices and areas for improvement. It is also useful in order to understand how cost-effectiveness performance has evolved over time for the Pan-European system as a whole, and for individual ANSPs.

The focus of this report is primarily on a cross-sectional analysis of ANSPs cost-effectiveness performance for the year 2016. In addition, this report makes use of previous years' data from 2011 onwards to examine changes over time, where relevant and valid. It is particularly useful to have a medium-term perspective given the characteristics of the ANS industry which requires a long lead time to develop ATC capacity and infrastructure.

1.1 Organisation of the report

The structure of the present ACE 2016 Benchmarking Report is made of two parts and four chapters:

Chapter 1 provides an overview of the participating ANSPs and outlines the processes involved in the production of this report.

Part I and Chapter 2 provide a high level analysis of economic and financial cost-effectiveness performance in 2016 at Pan-European system and ANSP level. This chapter also analyses changes in ATM/CNS cost-effectiveness performance between 2011 and 2016. A particular focus is put on the three main economic drivers of cost-effectiveness (productivity, employment costs and support costs). Chapter 2 also comprises a forward-looking analysis of ATM/CNS performance. Chapter 3 provides a high level analysis of ANSPs assets and liability structure. It also examines ANSPs capital expenditures with a focus on ATM systems.

Part II and Chapter 4 provide a two-page summary for each ANSP participating to the ACE programme. This summary includes an individual trend analysis of ANSPs' cost-effectiveness performance between 2011 and 2016, and comprises a benchmarking analysis of each ANSP's financial cost-effectiveness with a set of comparators. It also examines the capital expenditure

¹ Previous reports can be found on the PRC web site at <http://www.eurocontrol.int/prc/publications>.

² PRC Specification for Economic Information Disclosure - Version 3.0, December 2012, can be found on the PRC web site.

planned by ANSPs for the period 2017-2019 and how these plans compare to the previous capex cycles.

Finally, this report also comprises several annexes which include statistical data used in the report, and individual ANSP Fact Sheets comprising a factual description of the governance and institutional arrangements in which the ANSP operates.

1.2 Overview of participating ANSPs

In total, 38 ANSPs reported 2016 data in compliance with the requirement from Decision No. 88 of the Permanent Commission of EUROCONTROL.

Table 1.1 below shows the list of the ANSPs participating to the ACE 2016 benchmarking analysis, describing both their organisational and corporate arrangements, and the scope of ANS services provided.

It should be noted that the information reported under the column “delegated ATM” reflects the cases of ANS delegation to or from an ANSP based on an explicit financial agreement.

Table 1.1 also indicates (coloured yellow) which ANSPs were at 1 January 2016 part of the SES, and hence subject to relevant SES regulations and obligations. In addition to SES members, a number of States (coloured blue) are committed, following the signature of an agreement relating to the establishment of a European Common Aviation Area (ECAA)³, to cooperate in the field of ATM, with a view to extending the SES regulations⁴ to the ECAA States.

In addition, the European Union signed comprehensive air transport agreements with Georgia (December 2010) and Moldova (June 2012).

Hence, in principle all the en-route ANSPs of EUROCONTROL States⁵ and other States disclosing information to the PRC are to some extent covered by the SES regulations, except Armenia, Turkey and Ukraine.

³ Decision 2006/682/EC published on 16 October 2006 in the Official Journal of the European Union. States which have signed this Agreement but are not yet EU members comprise the Republic of Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, the Republic of Iceland, the Republic of Montenegro, the Kingdom of Norway, and the Republic of Serbia.

⁴ This includes the second package of SES regulations (EC No 1070/2009), the amended Performance Scheme Regulation (EC No 390/2013) and amended Charging Scheme Regulation (EC No 391/2013).

⁵ In 2016, en-route ANS in Bosnia and Herzegovina were provided by BHANSA from FL100 to FL325 and by Croatia Control and SMATSA between FL325 and FL660. BHANSA is not included in the ACE 2016 analysis but as it is becoming a full-fledged ANSP, it is expected to participate to the ACE benchmarking programme in the future.

	ANSP	Code	Country	Organisational & Corporate Arrangements	OAT Services	Oceanic	MUAC	Delegated ATM	Internal MET	Ownership and management of airports
1	Albcontrol	AL	Albania	Joint-stock company (State-owned)	x				x	
2	ANS CR	CZ	Czech Republic	State-owned enterprise						
3	ARMATS	AM	Armenia	Joint-stock company (State-owned)						
4	Austro Control	AT	Austria	Limited liability company (State-owned)					x	
5	Avinor	NO	Norway	Joint-stock company (State-owned)	x	x				x
6	Belgocontrol	BE	Belgium	State-owned enterprise			x		x	
7	BULATSA	BG	Bulgaria	State-owned enterprise					x	
8	Croatia Control	HR	Croatia	Joint-stock company (State-owned)	x			x	x	
9	DCAC Cyprus	CY	Cyprus	State body						
10	DFS	DE	Germany	Limited liability company (State-owned)	x		x			
11	DHMI	TR	Turkey	Autonomous State enterprise						x
12	DSNA	FR	France	State body (autonomous budget)				x		
13	EANS	EE	Estonia	Joint-stock company (State-owned)						
14	ENAI RE	ES	Spain	State-owned enterprise						
15	ENAV	IT	Italy	Joint-stock company (State-owned), listed company since July 2016					x	
16	Finavia	FI	Finland	State-owned enterprise	x			x	x	x
17	HCAA	GR	Greece	State body						x
18	HungaroControl	HU	Hungary	State-owned enterprise					x	
19	IAA	IE	Ireland	Joint-stock company (State-owned)		x				
20	LFV	SE	Sweden	State-owned enterprise	x			x	x	
21	LGS	LV	Latvia	Joint-stock company (State-owned)					x	
22	LPS	SK	Slovak Republic	State-owned enterprise						
23	LVNL	NL	Netherlands	Independent administrative body			x			
24	MATS	MT	Malta	Joint-stock company (State-owned)						
25	M-NAV	MK	F.Y.R. Macedonia	Joint-stock company (State-owned)	x				x	
26	MoldATSA	MD	Moldova	State-owned enterprise	x				x	
27	MUAC			International organisation						
28	NATS	UK	United Kingdom	Joint-stock company (part-private)		x		x		
29	NAV Portugal	PT	Portugal	State-owned enterprise		x				
30	NAVIAIR	DK	Denmark	State-owned enterprise	x					
31	Oro Navigacija	LT	Lithuania	State-owned enterprise						
32	PANSA	PL	Poland	State body (acting as a legal entity with an autonomous budget)						
33	ROMATSA	RO	Romania	State-owned enterprise					x	
34	Sakaeronavigatsia	GE	Georgia	Limited liability company (State-owned)					x	
35	Skyguide	CH	Switzerland	Joint-stock company (part-private)	x			x		
36	Slovenia Control	SI	Slovenia	State-owned enterprise	x					
37	SMATSA	RS	Serbia	Limited liability company	x			x	x	
		ME	Montenegro							
38	UkSATSE	UA	Ukraine	State-owned enterprise					x	

	States covered by the SES Regulations
	States part of the ECAA
	States that signed a CAA agreement with the EU
	States not covered by the SES Regulations

Table 1.1: States and ANSPs participating in ACE 2016

Table 1.1 also shows the extent to which the ANSPs incur costs relating to services that are not provided by all ANSPs. In order to enhance cost-effectiveness comparison across ANSPs, such costs, relating to oceanic ANS, military operational air traffic (OAT), airport management operations and payment for delegation of ATM services were excluded to the maximum possible extent.

1.3 Data submission

The SEID (see footnote 2) requires that participating ANSPs submit their information to the PRC/PRU by the 1st of July in the year following the year to which it relates. The ACE 2016 data have been submitted in the SEID Version 3.0 template which started to be used in the ACE 2014 Benchmarking Report. The information gathered remains fully compatible with Version 2.6, so that the time series analysed in this report are not affected by the use of Version 3.0.

Figure 1.1 indicates that 17 out of 38 ANSPs provided ACE 2016 data on time by the 1st July 2017. A number similar to that observed during the ACE 2015 data collection process.

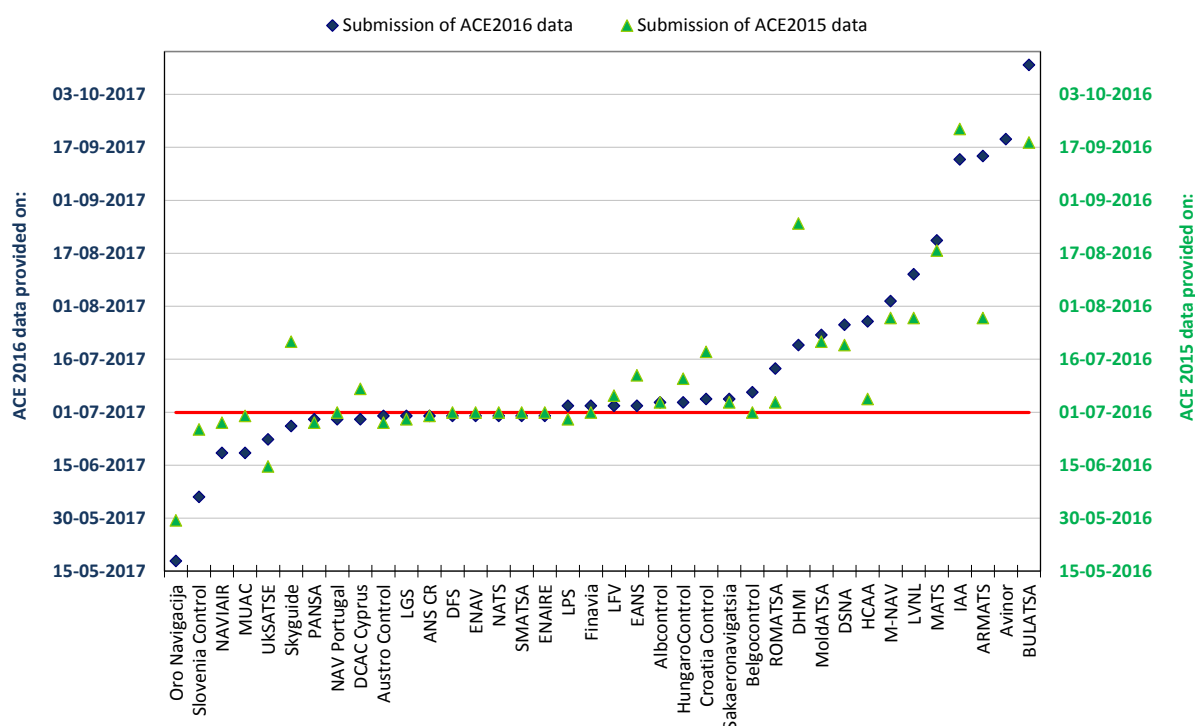


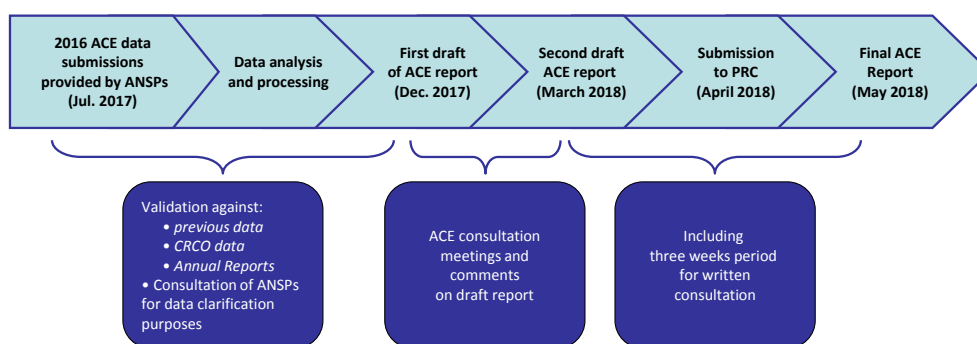
Figure 1.1: Progress with submission of 2016 data

It is important that the timely submission of ACE data is sustained and even improved. Robust ACE benchmarking analysis should be available in a timely manner since several stakeholders, most notably ANSPs' management, regulatory authorities (e.g. NSAs) and airspace users, have a keen interest in receiving the information in the ACE reports as early as possible. Clearly, the timescale for the production of the ACE Benchmarking Report is inevitably delayed if data are not submitted on time.

The general and gradual improvement in the quality and the timing of the ACE data submission is marred by some problems relating to few individual ANSPs. For instance, DSNA and HCAA are still not in a position to provide complete balance-sheet data, although capital-related costs are charged to airspace users.

1.4 Data analysis, processing and reporting

The PRU is supported by an ACE Working Group (WG), including ANSPs, regulatory authorities and airspace users' representatives. The process leading to the production of the ACE report, which comprises data analysis and consultation, is summarised in Figure 1.2 below.



EUROCONTROL/PRU 2017

Figure 1.2: Data analysis, processing and reporting

In order to ensure comparability among ANSPs and the quality of the analysis, the information submitted by the ANSPs is subject to a thorough analysis and verification process which makes extensive use of ANSPs' Annual Reports and of their statutory financial accounts.

During this process a number of issues emerged:

- Annual Reports with disclosure of financial accounts are not available for some ANSPs (see Section 1.5 below). This removes one means of validating the financial data submitted.
- ANSPs which are involved in non-ANS activities (such as airport ownership and management, see Table 1.1) do not necessarily disclose separate accounts for their ANS and non-ANS activities. This means that the financial data submitted for the ANS activities cannot be validated with the information provided in the Annual Report.
- Except for a few ANSPs, Annual Reports do not disclose the separate costs for the various segments of ANS (such as en-route and terminal ANS) which means that the cost breakdown provided under the En-route and Terminal columns in the ACE data submissions cannot be fully reconciled.

As ANSPs progressively comply with the SES Regulation on Service Provision, which requires publication of Annual Reports including statutory accounts, and separation of ANS from non-ANS activity in ANSPs internal accounts, some of these shortcomings are expected to be gradually overcome (see also Section 1.5 below).

In most cases, data recorded in the Network Manager (NM) database have been used as the basis for the output metrics used in the ACE data analysis, and this practice has been generally accepted, including in cases where in previous years there had been discrepancies.

1.5 ANSPs' Annual Reports

ANSPs' Annual Reports provided a valuable means of validating the 2016 information disclosure data.

The SES Service Provision Regulation (SPR) (EC No 550/2004) came into force on 20 April 2004 and is applicable to 2016 Financial Accounts in all EU Member States (plus Switzerland and Norway) and associated ANSPs. This Regulation is also applicable to States which have signed the ECAA agreement or a Common Aviation Area agreement with the European Union (see Section 1.2), although the timing of its implementation is not yet decided for individual States. Among other provisions, the SPR requires that ANSPs meet certain standards of information disclosure (transparency) and reporting, and in particular that:

- ANSPs should draw up, submit to audit and publish their Financial Accounts (Art.12.1);
- in all cases, ANSPs should publish an Annual Report and regularly undergo an independent audit (Art 12.2); and,
- ANSPs should, in their internal accounting, identify the relevant costs and income for ANS broken down in accordance with EUROCONTROL's principles for establishing the cost-base for route facility charges and the calculation of unit rates and, where appropriate, shall keep consolidated accounts for other, non-air navigation services, as they would be required to do if the services in question were provided by separate undertakings (Art 12.3). The latter requirement is particularly relevant for the ANSPs which are part of an organisation which owns, manages and operates airports, such as Avinor, HCAA, and DHMI⁶.

⁶ Although it should be noted that DHMI is not covered by the SES regulations.

Figure 1.3 displays the status of ANSPs 2016 Annual Reports and indicates that 31 out of 38 participating ANSPs have published an Annual Report for the year 2016.

It is generally considered that an Annual Report produced according to “best practice” should comprise three main components:

- a Management Report;
- annual Financial Accounts with relevant business segmentation and explanatory notes; and,
- an independent Audit Report.

At the time of writing this report, 7 ANSPs (including 3 which are subject to SES Regulations) have not published Annual Reports for 2016.

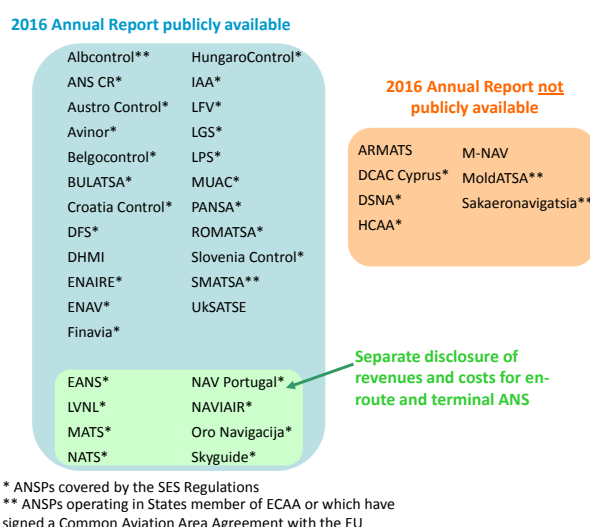


Figure 1.3: Status of 2016 Annual Reports

ANSPs’ Annual Accounts are prepared in accordance with specific accounting principles. Often, (national) General Accepted Accounting Principles (GAAP) are used.

In the context of the SES, Article 12 of the SPR prescribes that ANSPs Annual Accounts shall comply, to the maximum extent possible, with International Financial Reporting Standards (IFRS). Table 1.2 shows the 27 ANSPs whose 2016 Annual Accounts were partly or fully prepared according to IFRS⁷.

ANSPs reporting according to IFRS in 2016	
Albcontrol	LVNL
ANS CR	MATS
ARMATS	MUAC
Austro Control	NATS
Avinor	NAV Portugal
BULATSA	NAVIAIR
Croatia Control	Oro Navigacija
DFS	PANS*
EANS	Sakaeronavigatsia
ENAIRE	Skyguide
ENAV	Slovenia Control
HungaroControl	SMATSA
LGS	UKSATSE
LPS	

Table 1.2: IFRS reporting status

It should be noted that in some cases, the implementation of IFRS may have a significant impact on an ANSPs’ cost base^{8, 9} (such as different treatment of costs related to the pension scheme, and changes in depreciation rules), hence it is very important to identify and understand the impact of changes in the accounting principles used to draw the financial accounts.

⁷ Skyguide Annual Accounts are prepared according to the Swiss GAAP which are close to IFRS.

⁸ From 2007 onwards, this has been the case for the German ANSP, DFS, whose cost base includes costs recognised only since the conversion to IFRS. These costs, mainly due to the revaluation of DFS pension obligations, have been spread over a period of 15 years.

⁹ Following the amendment of IAS 19 in 2013, any gains/losses arising from a change in actuarial assumptions have to be directly reflected in financial statements. This contrasts with the methodology that was used by some ANSPs until 2012 (i.e. corridor approach) according to which only a part of the actuarial gains/losses were recognised in the financial statements.

1.6 ANSP benchmarking and the SES Performance Scheme

The SES Performance Scheme includes Union-wide performance targets which are “transposed” into binding national/FAB targets for which clear accountabilities must be assigned within performance plans. Following the PRB recommendations, Union-wide targets for Safety, Environment, Capacity and Cost-Efficiency were adopted by the EC on 11 March 2014 for RP2 (2015-2019)¹⁰. It should be noted that the Union-wide Cost-Efficiency target is expressed in terms of en-route determined costs per service unit, and is computed at charging zone level (i.e. including ANSPs, MET, EUROCONTROL and NSAs costs). At Union-wide level, the en-route Cost-Efficiency target for RP2 corresponds to an annual average reduction of the Determined Unit Cost of -3.3%.

SES States/ANSPs operate under the determined costs method which comprises specific risk-sharing arrangements aiming at incentivising ANSPs economic performance. As part of the determined costs method, the costs planned for the reference period (RP) are set in advance and frozen for the length of the RP. If actual costs are lower than the determined costs, then the State/ANSP can keep the difference. On the contrary, if actual costs are higher than determined, then the State/ANSP has to bear a loss. This mechanism provides incentives for States/ANSPs to effectively control their costs and to flexibly adapt to unforeseen changes in traffic volumes.

The 2016 PRB monitoring report shows that for the first year of RP2, SES States were, on average, able to outperform their en-route cost-efficiency targets (-6.1%) since they managed to achieve cost savings (-1.9%) while benefiting from more traffic (measured in terms of total service units) than expected (+4.4%).

This ACE 2016 Benchmarking Report complements the PRB monitoring activity by providing a detailed comparison of cost-effectiveness performance at ANSP level including a trend analysis of three main economic drivers (productivity, employment costs and support costs) over the 2011-2016 period. Performance indicators at FAB level are also presented in Annex 9.

Annex 3 provides explanations on the differences between ACE and SES economic indicators and illustrates how these can be reconciled.

¹⁰ The EC decision (2014/132/EU) setting RP2 performance targets is available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014D0132&from=EN>.

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PART I: PAN-EUROPEAN SYSTEM COST-EFFECTIVENESS PERFORMANCE IN 2016 AND OUTLOOK FOR 2017-2019

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2 PAN-EUROPEAN SYSTEM COST-EFFECTIVENESS PERFORMANCE IN 2016 WITH 2017-2019 OUTLOOK

2.1 Overview of European ANS system data for the year 2016

In 2016, gate-to-gate ATM/CNS provision costs amounted to some €8.1 billion which represent around 88% of the Pan-European system ANS costs (€9.2 billion).

The Pan-European ANS system analysed in this report comprises 38 participating ANSPs, excluding elements related to services provided to military operational air traffic (OAT), oceanic ANS, and landside airport management operations. The Pan-European ANS system also includes National Supervisory Authorities (NSAs) and other regulatory and governmental authorities, national MET providers and the EUROCONTROL Agency.

Table 2.1 below presents key ANSP data for the years 2015 and 2016. Table 2.1 shows that the gate-to-gate ANS revenues amounted to €9 375M in 2016 and slightly reduced by -0.2% compared to 2015. On the other hand, gate-to-gate ANS costs (€9.2 billion) were +0.8% higher than in 2015.

Table 2.1 also shows that the main component of gate-to-gate ANS costs is ATM/CNS provision costs (€8.1 billion) with a share of 87.6%. Other ANS costs include the costs of aeronautical meteorology services (4.8%), the costs of the EUROCONTROL Agency (5.4%) and the costs associated to regulatory and governmental authorities (2.2%).

The Pan-European ANSPs employed some 55 915 staff. Overall, at system level each staff generated an average of some €168 000 in terms of revenues. Some 17 888 staff (32%) were ATCOs working on operational duty, split between ACCs (55%) and APP/TWR facilities (45%). On average, 2.1 additional staff are required for every ATCO in OPS in Europe.

	2015	2016	16/15
	38 ANSPs	38 ANSPs	38 ANSPs
Gate-to-gate ANS revenues (not adjusted by over/under recoveries) (in € M):	9 397	9 375	-0.2%
<i>En-route ANS revenues</i>	7 471	7 450	-0.3%
<i>Terminal ANS revenues</i>	1 927	1 924	-0.1%
Gate-to-gate ATM/CNS provision costs (in € M):	8 039	8 092	0.7%
<i>En-route ATM/CNS costs</i>	6 275	6 342	1.1%
<i>Terminal ATM/CNS costs</i>	1 763	1 750	-0.8%
Institutional costs (in € M):	1 125	1 147	2.0%
<i>MET costs (including internal MET costs)</i>	436	445	2.2%
<i>EUROCONTROL Agency costs</i>	496	497	0.2%
<i>Payment to national authorities and irrecoverable VAT</i>	193	205	6.1%
Gate-to-gate ANS costs (in € M)	9 164	9 239	0.8%
Gate-to-gate ANS staff:	56 343	55 915	-0.8%
<i>ATCOs in OPS</i>	17 674	17 888	1.2%
<i>ACC ATCOs</i>	9 870	9 917	0.5%
<i>APPs + TWRs ATCOs</i>	7 803	7 971	2.1%
NBV of gate-to-gate fixed assets (in € M)	7 245	7 289	0.6%
Gate-to-gate capex (in € M)	1 022	1 108	8.4%
Outputs (in M)			
Distance controlled (km)	10 509	10 869	3.4%
Total flight-hours controlled	14.9	15.4	2.8%
ACC flight-hours controlled	13.3	13.7	2.7%
IFR airport movements controlled	15.2	15.4	1.2%
IFR flights controlled	9.8	10.0	2.7%
Gate-to-gate ATFM delays ('000 min.)	13 946	15 364	10.2%

Table 2.1: Key ANSP data for 2015 and 2016, real terms

ACE also analyses indicators derived from ANSP balance-sheets and capital expenditures. The total Net Book Value (NBV) of fixed assets employed by the Pan-European ANSPs to provide ATM/CNS services is valued at some €7 289M, which means that overall €0.8 of fixed assets are required to generate €1 of revenue, an indication of relative capital intensity (this ratio is about 2 for airlines and about 3 for main airports operators). Fixed assets mainly relate to ATM/CNS systems and equipment in operation or under construction. In 2016, the total ANSP capex at Pan-European system level amounted to some €1 108M. Further details on ANSPs balance-sheet structure and capex are provided in Chapter 3 of this report.

Table 2.1 indicates that the minutes of gate-to-gate ATFM delays rose from 13 946'000 to 15 364'000 minutes between 2015 and 2016, an increase of +10.2%. Caution is required when interpreting this change since as of April 2016 the Network Manager (NM) introduced a new methodology to improve the accuracy of ATFM delays calculation. This change resulted in substantially less ATFM delays compared to those computed using the old methodology. When computed according to the old methodology, the minutes of gate-to-gate ATFM delays rose by +23.3% in 2016. Further details on the impact of this new calculation methodology on the computation of the economic cost-effectiveness indicator are provided in Section 2.3 of this report.

Some elements of ANS provision are outside the control of individual ANSPs. These elements include the costs of aeronautical MET services, the costs of the EUROCONTROL Agency and costs associated to regulatory and governmental authorities. Therefore, from a methodological point of view, the ACE Benchmarking analysis focuses on the specific costs of providing gate-to-gate ATM/CNS services which amounted to €8 092M in 2016.

Figure 2.1 shows for each ANS segment the costs distribution between staff costs, non-staff operating costs, depreciation costs, the cost of capital and exceptional costs.

2016 Gate-to-gate ATM/CNS provision costs (European level) €8 092M	
En-route ATM/CNS costs (European level) €6 342M	Terminal ATM/CNS costs (European level) €1 750M
Staff costs €4 075M	Staff costs €1 191M
Non-staff operating costs €1 003M	Non-staff operating costs €294M
Depreciation costs €784M	Depreciation costs €159M
Cost of capital €416M	Cost of capital €89M
Exceptional costs €65M	Exceptional costs €17M

Figure 2.1: Breakdown of ATM/CNS provision costs, 2016

Staff costs are by far the largest costs category (65%), followed by non-staff operating costs (17% including exceptional items), depreciation costs (12%) and the cost of capital (6%).

Figure 2.1 also shows that gate-to-gate ATM/CNS provision costs can be broken down into en-route and terminal representing respectively 78% and 22% of gate-to-gate costs.

Despite the existence of common general principles, there are inevitably discrepancies in cost-allocation between en-route and terminal ANS across the European ANSPs. This lack of consistency might distort performance comparisons carried out separately for en-route and terminal. For this reason, the focus of the cost-effectiveness benchmarking analysis in this report is “gate-to-gate”. For the sake of completeness, Annex 2 of this report provides the breakdown of the gate-to-gate cost-effectiveness indicator into en-route and terminal.

ANSPs’ ATM/CNS provision costs are then divided by an output metric to obtain a measure of performance – the **financial cost-effectiveness indicator**. The output metric is the composite flight-hour, a “gate-to-gate” measure which combines both en-route flight-hours controlled and IFR airport movements controlled. More information on the calculation of the output metric can be found in Annex 2.

2.2 Factors affecting performance

ANSPs in Europe operate in very diverse environments, both in terms of operational conditions (e.g. traffic complexity and traffic variability) and socio-economic conditions (e.g. cost of living, labour laws).

There are also significant differences in terms of size across the ANSPs since the five largest bear 57% of the total Pan-European ATM/CNS provision costs while the five smallest represent less than 1% of the costs.

Many factors contribute to observed differences in unit costs between ANSPs. Some of these factors are measurable; others (such as regulatory constraints) are less obviously quantifiable.

Methods have been developed by the PRU to measure a subset of exogenous factors. Currently, three relevant factors outside ANSPs control are consistently measured in the ACE Benchmarking Reports. As shown in Figure 2.2 below, these include the traffic complexity and the seasonal traffic variability. The third factor is the cost of living prevailing in the different countries where ANSPs operate.

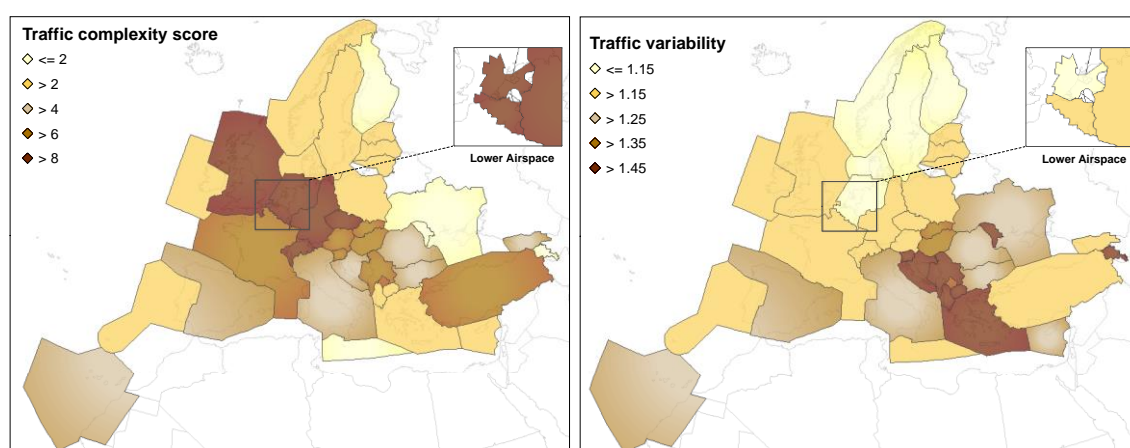


Figure 2.2: Exogenous factors measured by the PRU, 2016

Figure 2.2 shows that traffic complexity scores¹¹ tends to be very high in the core of Europe (see left-hand map), while the seasonal traffic variability tends to be very high in the South-East corner of Europe (see the right-hand map). It should be noted that in Figure 2.2, the seasonal traffic variability metric is computed as the ratio of the peak week of traffic to the average week.

Detailed information on traffic complexity and seasonal variability are provided in Annex 6 of this report.

Ideally, since the 38 ANSPs operate in very diverse environments across Europe, all the factors affecting performance should be taken into account in making fair performance comparisons, especially since many of these factors are outside the direct control of an ANSP. As in previous years, the analysis undertaken is a purely **factual** analysis of the cost-effectiveness indicators – measuring what the indicators **are**.

¹¹ The Base of Aircraft Database (BADA) version 3.6.1 has been used to compute the speed interactions component of the traffic complexity scores which are presented in this report but also in previous years' reports. A new version of the BADA database (3.13.1) is currently used to compute the traffic complexity scores for the year 2017. The use of this different database affects the level of the speed interactions indicator but also of the aggregated traffic complexity score. The impact of this change on traffic complexity values will be assessed as part of the ACE 2017 benchmarking analysis.

The impact of size on ANSPs performance is an important policy issue given the infrastructure characteristics of the ANS sector and the expectation that fixed costs can be more effectively exploited with larger amounts of traffic.

In 2016, the five largest ANSPs (ENAI, DFS, ENAV, NATS and DSNA) bear some 57% of total European gate-to-gate ATM/CNS provision costs, while their share of traffic is 50%. At first sight, this result contrasts with the expectation of some form of increasing returns to scale in the provision of ANS (the performance of larger ANSPs might benefit from their larger size).

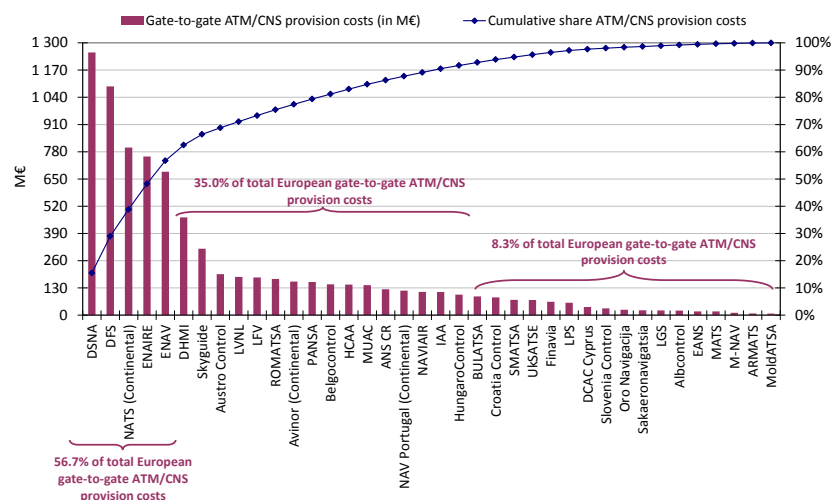


Figure 2.3: Distribution of ATM/CNS provision costs in 2016

However, it should be noted that:

- under the full cost recovery regime that applied to most ANSPs until December 2011, there was little incentive to fully exploit scale effects;
- the five largest ANSPs were substantially affected by the decrease in traffic volumes resulting from the economic recession. On average, the number of composite flight-hours controlled by the five largest ANSPs reduced by -5.3% between 2008 and 2016 while it rose by +11.1% for the other ANSPs;
- larger ANSPs tend to develop bespoke ATM systems internally which can be more costly than commercial off-the-shelf (COTS) solutions; and,
- size is not the only factor that has an impact on ANSPs costs.

It is expected that with the regulatory regime introduced by the SES II Performance Scheme and the incentive scheme embedded in the Charging Scheme regulation, the incentives to exploit scale effects will be stronger in RP2.

2.3 Pan-European economic cost-effectiveness performance in 2016

At Pan-European level, the unit economic costs amounted to €494 in 2016. Gate-to-gate ATFM delays increased for the third year in a row while unit ATM/CNS provision costs decreased (-1.7%) in a context of traffic increase (+2.4%).

An assessment of ANS performance should take into account the direct costs linked with ATM/CNS provision but also indirect costs (delays, additional flight time and fuel burn) borne by airspace users, while checking that ANS safety standards are met. The PRC introduced in its ACE Benchmarking Reports the concept of economic cost-effectiveness. This indicator is defined as gate-to-gate ATM/CNS provision costs plus the costs of ground ATFM delays¹² for both en-route

¹² The cost of ATFM delays (€100 per minute in 2016, the same value as in 2015) is based on the findings of the study “European airline delay cost reference values” realised by the University of Westminster in March 2011 and updated in December 2015. Further details on the computation of the economic costs per composite flight-hour at ANSP and Pan-European system level are available in Annex 2 of this report.

and airport, all expressed per composite flight-hour. This economic performance indicator is meant to capture trade-offs between ATC capacity and costs.

Figure 2.4 below shows the comparison of ANSPs gate-to-gate economic cost per composite flight-hour in 2016. The two dotted lines represent the bottom and the top quartiles and provide an indication of the dispersion across ANSPs (there is a difference of €178 between the bottom and the top quartile).

The economic cost-effectiveness indicator at Pan-European level is €494 per composite flight-hour, and, on average, ground ATFM delays represent 16% of the total economic costs.

Figure 2.4 below shows that in 2016 unit economic costs ranged from €924 for Belgocontrol to €198 for MATS; a factor of more than four. Figure 2.4 also shows that DFS had the highest unit economic costs amongst the five largest ANSPs.

It is important to note that, for ANSPs operating outside of the Euro zone (such as Skyguide and NATS), substantial changes of the national currency against the Euro may significantly affect the level of 2016 unit economic costs when expressed in Euro.

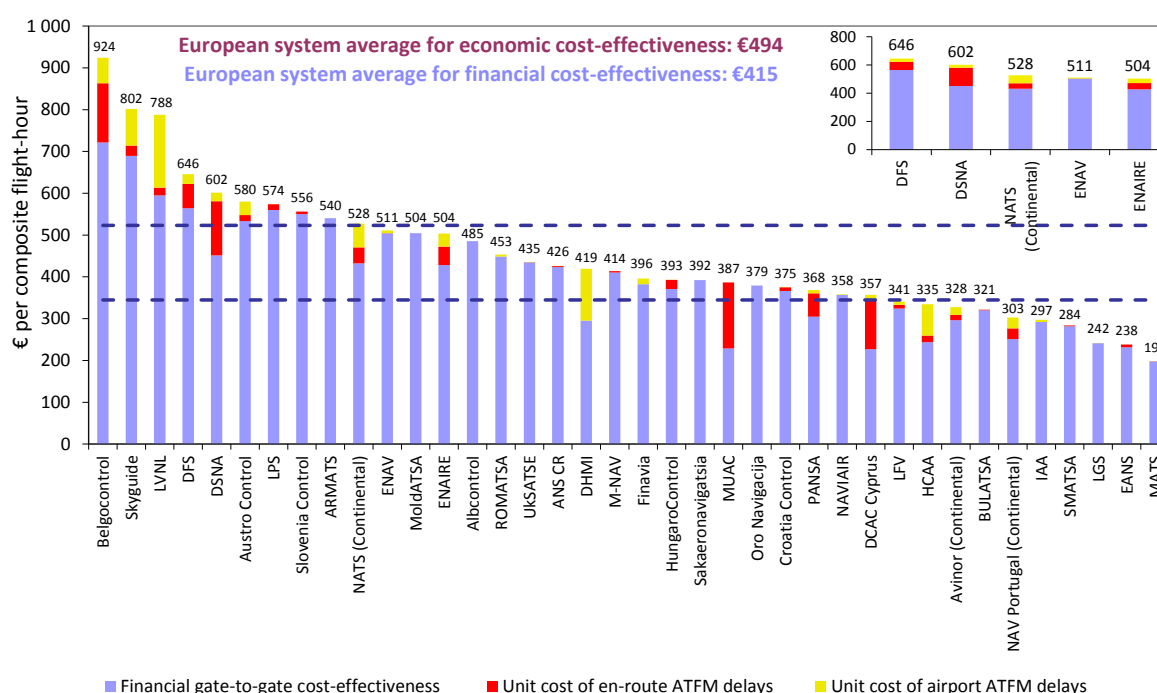


Figure 2.4: Economic gate-to-gate cost-effectiveness indicator, 2016

Figure 2.5 below analyses the changes in economic cost-effectiveness between 2011 and 2016 at Pan-European system level. The left-hand side of Figure 2.5 shows the changes in unit economic costs, while the right-hand side provides complementary information on the year-on-year changes in ATM/CNS provision costs, composite flight-hours and unit costs of ATFM delays¹³.

Figure 2.5 indicates that between 2011 and 2015, economic costs per composite flight-hour decreased by -1.6% p.a. in real terms, mainly due to decreases in ATFM delays unit costs (-6.4% p.a.) on average over the period. In the meantime, ATM/CNS provision costs (-0.2% p.a.) remained close to their 2011 level while composite flight-hours slightly rose(+0.5% p.a.).

¹³ It should be noted that the ATFM delays analysed in this ACE Benchmarking Report do not comprise changes due to the Post Operations Performance Adjustment Process. More information on this process is provided in Annex 2 of this report.

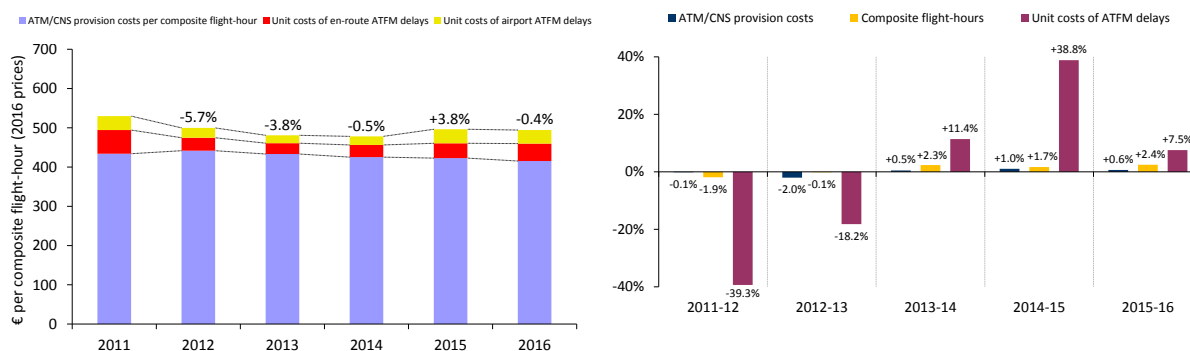


Figure 2.5: Changes in unit economic costs, 2011-2016 (real terms)

Figure 2.5 also shows that in 2016, at face value, unit economic costs reduced by -0.4% compared to 2015 given that the increase in the unit costs of ATFM delays (+7.5%) was more than compensated by a reduction in unit ATM/CNS provision costs (-1.7%) since traffic rose faster (+2.4%) than ATM/CNS provision costs (+0.6%).

However, it is important to note that the change in the unit costs of ATFM delays (+7.5%) shown in Figure 2.5 is affected by a change in the methodology used by the EUROCONTROL Network Manager to calculate delays¹⁴ in April 2016. This change resulted in substantially less ATFM delays compared to those computed for the previous years. When computed according to the old methodology, the unit costs of gate-to-gate ATFM delays rose by +20.3% in 2016 and unit economic costs were +1.5% higher than in 2015. This adjustment is shown in Figure 2.6 below.

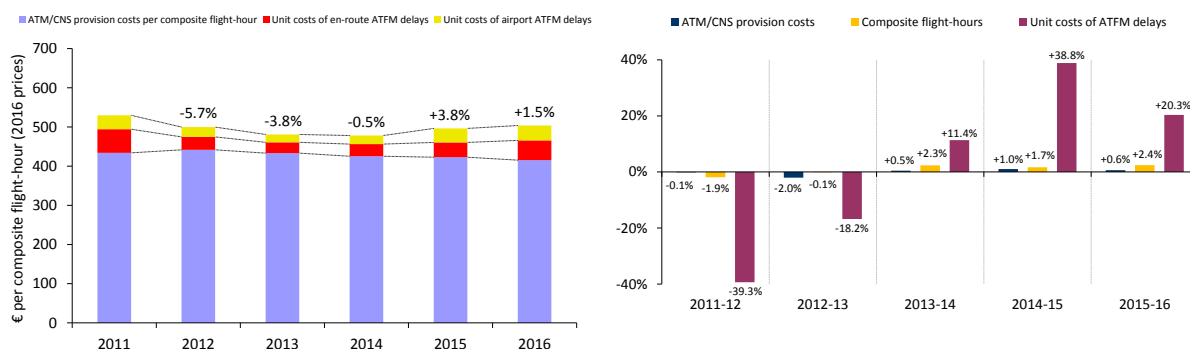


Figure 2.6: Adjusted changes in unit economic costs, 2011-2016 (real terms)

In order to ensure consistency in time series analysis, the changes in unit economic costs and ATFM delays analysed in this ACE 2016 report will be computed using the old calculation methodology.

¹⁴ ANSPs noticed that the use of the Ready Message (REA) - whilst attempting to improve punctuality for aircraft – could result in artificial changes to the computed ATFM delay for individual flights and for the ANSP that has requested the regulation. The ANSPs brought this to the attention of the Network Management Board (NMB). The ANSPs, together with the airspace users and the Network Manager reviewed the existing situation and developed a more accurate process which avoids artificial changes to the computed ATFM delay when a REA message is used. The more accurate process was presented to the NMB and approved in March 2015 for implementation with NM software release 20.0 on April 04 2016. More information on this adjustment is available at: http://ansperformance.eu/references/methodology/ATFM_delay_calculation.html and in the 2016 NM Network Operation Report (<http://www.eurocontrol.int/publications/annual-network-operations-report-2016>).

Figure 2.7 shows the long term trends in terms of ATM/CNS provision costs, composite flight-hours, ATFM delays and unit economic costs.

The trend of decreasing ATFM delays which began in 2011 stopped in 2014, when a new cycle characterised by higher delays started (+14.0% in 2014, +41.1% in 2015 and +23.3% in 2016).

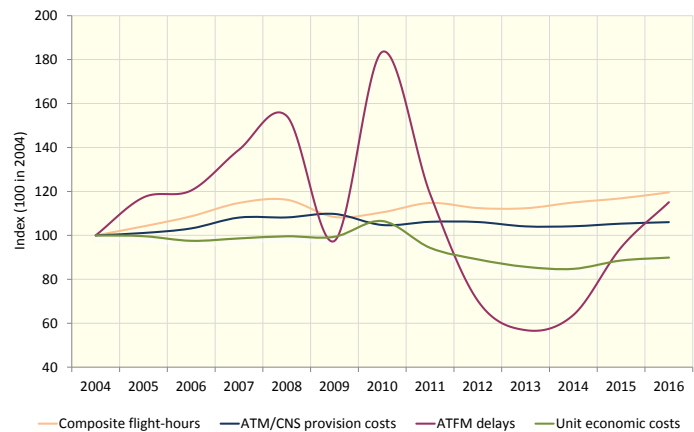


Figure 2.7: Long-term trends in traffic, ATM/CNS provision costs and ATFM delays

Recent analyses indicate that this increasing trend continued in 2017 albeit in a lower magnitude since en-route ATFM delays were +7.1% higher than in 2016.

In Figure 2.8 below, ANSPs are classified in two groups. The upper bar chart shows ANSPs with a relatively higher aggregated complexity score (i.e. higher than the median of the sample which represents a score of 4.5) while ANSPs with a relatively lower aggregated complexity score (i.e. equal or lower than the median of the sample) are shown in the bottom bar chart. Inside each group, ANSPs are ranked by unit economic costs. More information about complexity indicators measured at ANSP level is available in Annex 6.

Note that as in Figure 2.6 and Figure 2.7 above, the unit costs of ATFM delays for the year 2016 were computed according to the old methodology in order to ensure consistency in trend analysis and to provide a more realistic picture of the changes in ATFM delays.

Figure 2.8 shows that between 2015 and 2016, gate-to-gate economic costs per composite flight-hour fell for 17 ANSPs. Substantial reductions are observed for DCAC Cyprus (-47.4%), Croatia Control (-26.2%) and HCAA (-18.4%). For these ANSPs, the reduction in unit economic costs is mainly driven by a large decrease in the unit costs of ATFM delays.

On the other hand, Figure 2.8 also shows that unit economic costs rose for 21 ANSPs. For MUAC (+30.2%), Belgocontrol (+21.8%) and PANSAs (+11.9%), higher ATFM delays significantly contributed to the observed increase in unit economic costs.

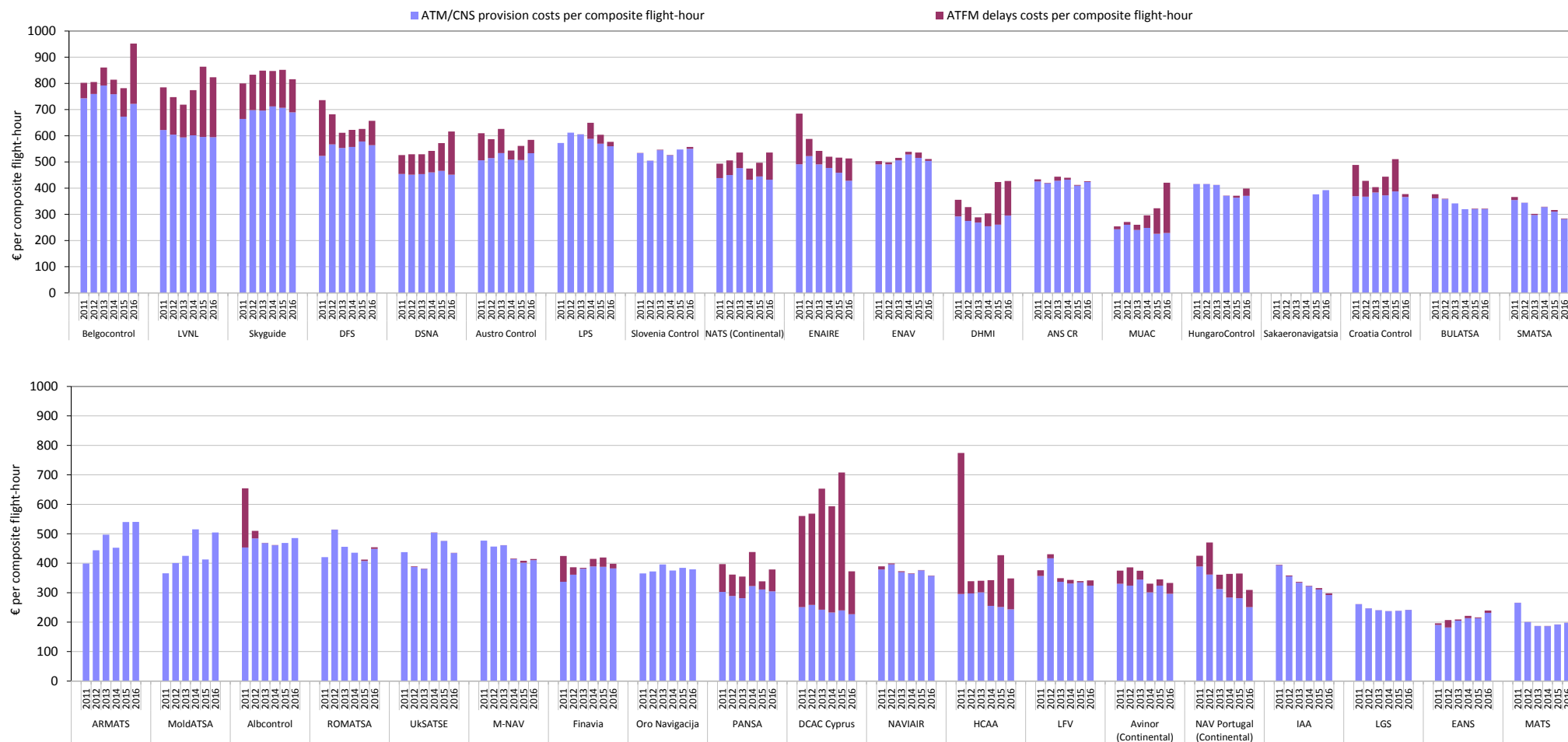


Figure 2.8: Changes in economic cost-effectiveness by ANSP, 2011-2016 (real terms)

Figure 2.9 below shows the contribution of each ANSP to the change in ATFM delays observed in 2016 at Pan-European system level.

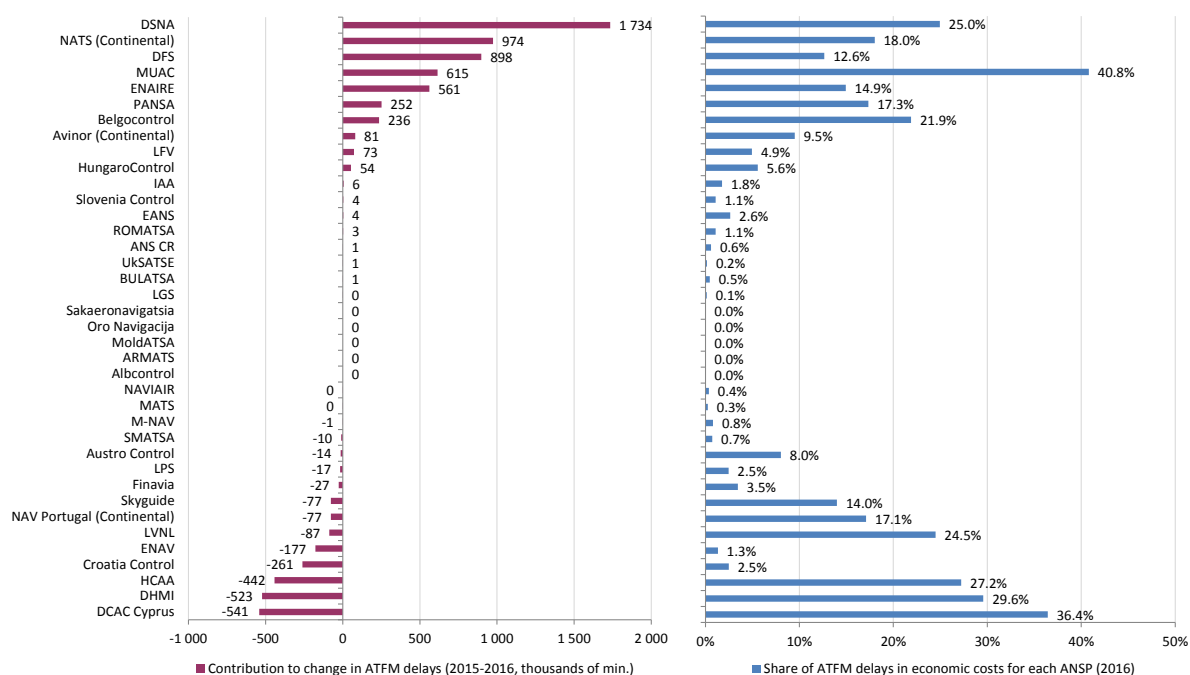


Figure 2.9: ANSPs contribution to ATFM delays increase at Pan-European system level in 2016

Figure 2.9 indicates that the increase in ATFM delays observed at system level in 2016 mainly reflects very large increases for a few ANSPs. Indeed, five ANSPs (DFS, DSNA, ENAIRES, NATS and MUAC) generated some 4 782 000 additional minutes of ATFM delays in 2016. The main factors explaining the increase in ATFM delays for the top five contributors are:

- the training and implementation of the ERATO stripless environment at Brest ACC, as well as industrial actions for DSNA;
- the training and implementation of the new iTEC ATM system in Prestwick ACC for NATS in the first half of 2016;
- weather and ATC capacity issues in Karlsruhe ACC during the Summer period for DFS;
- capacity issues mainly due to shifting traffic flows for MUAC, as well as, adverse weather phenomena; and,
- capacity issues in Barcelona and Canarias ACCs for ENAIRES.

The right-hand side of Figure 2.9 shows that, as a result, for MUAC the share of ATFM delays in economic costs in 2016 (40.8%) is the highest in Europe, well above the Pan-European average (16%).

On the other hand, five ANSPs (Croatia Control, DCAC Cyprus, DHMI, ENAV and HCAA) achieved significant reductions in ATFM delays. It should be noted that for DCAC Cyprus (36.4%), DHMI (29.6%) and HCAA (27.2%) despite the substantial reduction achieved in 2016, the share of ATFM delays in economic costs remains much higher than the Pan-European average (16%).

Figure 2.10 shows the breakdown of ATFM delays by segment and delay cause. This information reflects the data currently recorded in the Network Manager database. In 2016, airport ATFM delays represented 44% of the total ATFM delays of which 51% were caused by aerodrome or ATC capacity problems. This could rise up to more than 80% for individual ANSPs (see Figure 2.11

below). Weather issues, which may be difficult for the ANSP to influence, accounted for 44% of total airport delays in 2016.

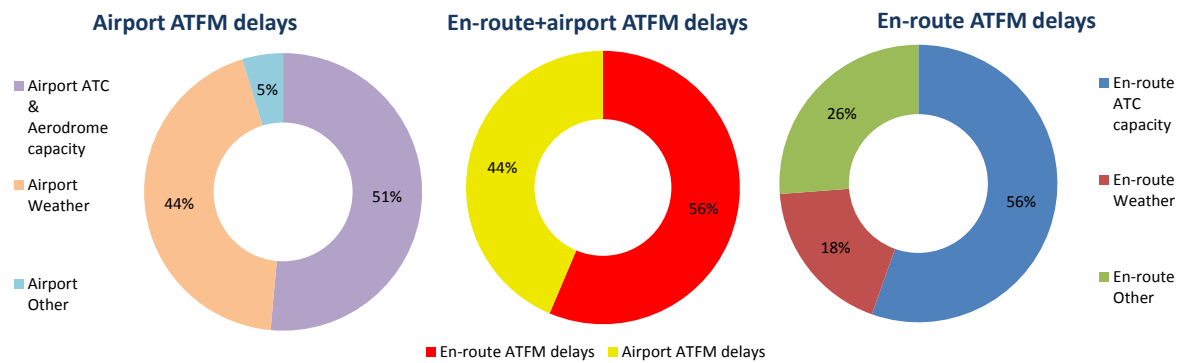


Figure 2.10: Causes of en-route and airport ATFM delays at system level, 2016

Most of the en-route ATFM delays generated at Pan-European system level are associated to ATC capacity issues (56%).

Figure 2.11 shows the distribution of delays by cause for the 15 ANSPs which generated more than 100 000 minutes of ATFM delays in 2016.

The right-hand side of Figure 2.11 indicates that, for the most of the ANSPs, en-route ATFM delays are mainly associated with ATC capacity issues (see blue bar). This is particularly the case for Avinor, Belgocontrol, DCAC Cyprus, ENAIRE, HCAA, NAV Portugal, PANSA and Skyguide for which more than 75% of en-route delays were attributed to ATC capacity issues. For Austro Control, en-route ATFM delays in 2016 were mainly associated with weather issues.

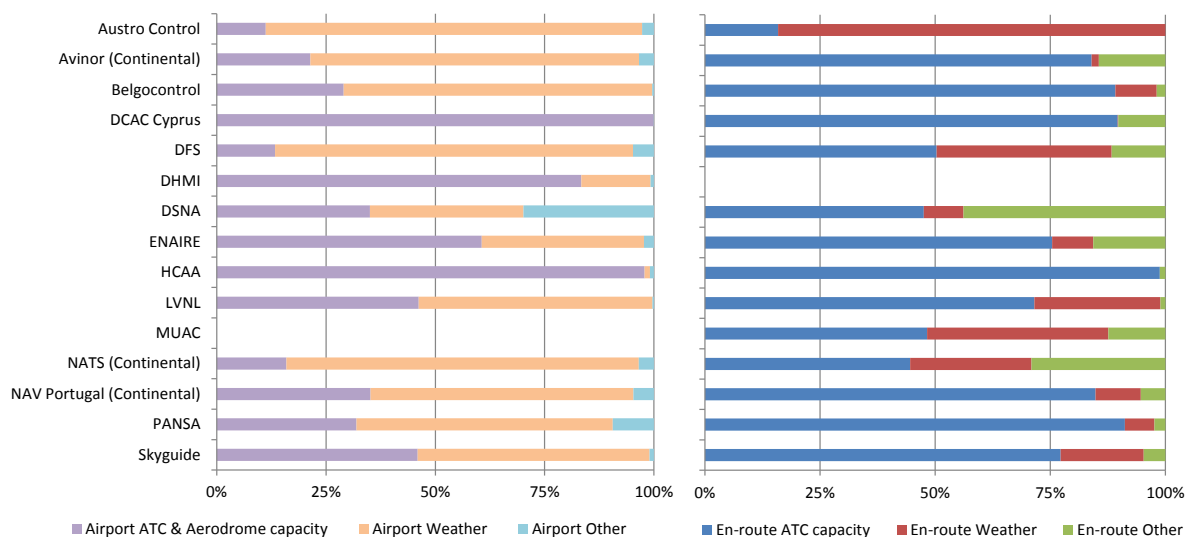


Figure 2.11: Causes of en-route and airport ATFM delays at ANSP level, 2016

The left-hand side of Figure 2.11 shows that the airport ATFM delays recorded for DCAC Cyprus, DHMI, ENAIRE and HCAA were mainly related to aerodrome capacity issues (see light purple bar). On the other hand, the airport ATFM delays for Austro Control, Avinor, Belgocontrol, DFS, DSNA, LVNL, NATS, NAV Portugal, PANSA and Skyguide were mainly due to weather (see orange bar). This reflects the impact of the adverse weather conditions faced by these ANSPs during the year 2016.

It is important to note that airport ATFM delays, and associated costs, may also arise from airport constraints, which are outside the direct control of the respective ANSP (such as compliance with environmental constraints or issues associated with airport infrastructure).

In absence of exceptional events (i.e. severe weather, industrial actions, etc.), the level of ATFM delays should mainly depend on the extent to which the ATC capacity provided by an ANSP is in line with the traffic demand. In the medium-term, the level of capacity provided can be gradually increased through a variety of measures including the recruitment of additional ATCOs and capital investment (e.g. ATM systems with higher capabilities, etc.).

It is important to note that in 2016, according to information provided in PRR 2016, ATFM delays represented some 16% of the total delays faced by passengers.

More details on the changes in ATFM delays for individual ANSPs are provided in Part II of this Report and delay causes are further analysed in the PRR 2016 report as well as in the Network Operations Report 2016 (see footnote 14). Additional information on ATFM delays can also be found on the Performance Review Unit data portal (<http://ansperformance.eu/>).

2.4 Pan-European financial cost-effectiveness performance in 2016

In 2016, unit ATM/CNS provision costs range from €722 (Belgocontrol) to €198 (MATS). Although the five largest ANSPs operate in relatively similar economic and operational environments, there is a substantial variation in unit ATM/CNS provision costs, ranging from DFS (€564) to ENAIRE (€428).

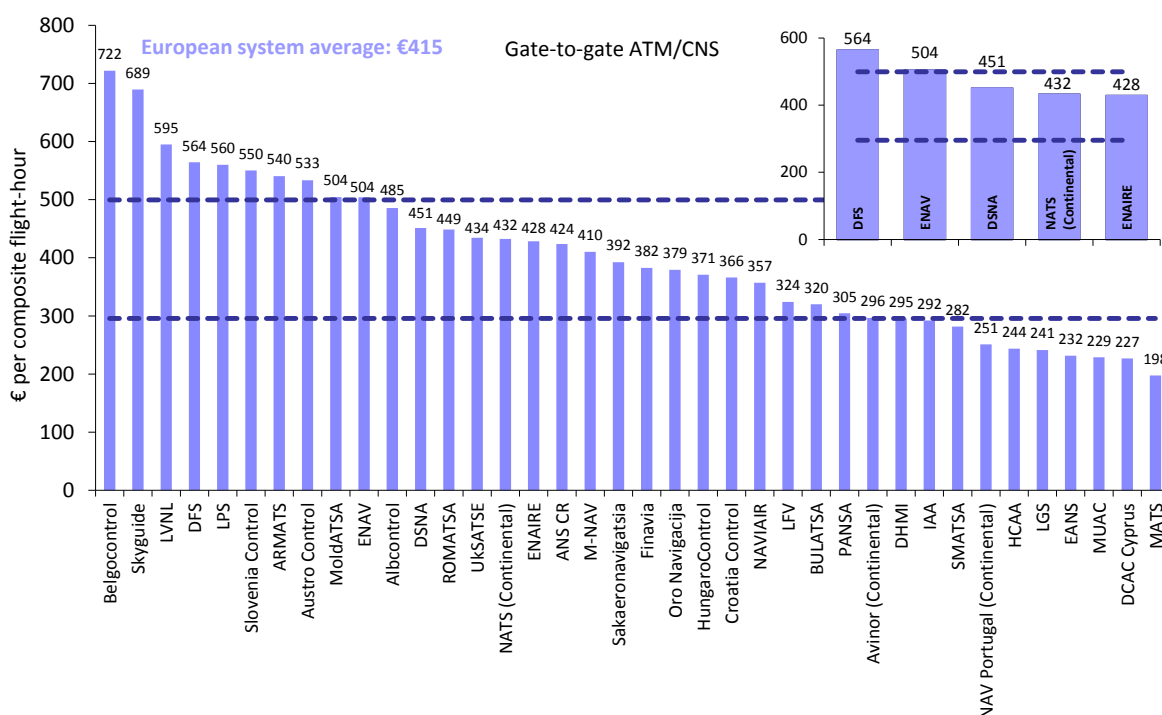


Figure 2.12: ATM/CNS provision costs per composite flight-hour, 2016

It is important to note that, for ANSPs operating outside the Euro zone, substantial changes of the national currency against the Euro may significantly affect the level of unit ATM/CNS provision costs when expressed in Euros. For example, the level of Skyguide unit costs (€689) is negatively affected by the substantial changes of the Swiss Franc against the Euro over the recent years (appreciation of some +14% in 2015). Assuming that the Swiss Franc had remained at its 2014 level, Skyguide 2016 unit ATM/CNS provision costs would amount to some €619, instead of €689. Detailed information on ANSPs exchange rates is available in Annex 7 of this report.

Figure 2.12 indicates that in 2016 the unit ATM/CNS provision costs of various ANSPs operating in Central and Eastern European countries (LPS, Slovenia Control, ARMATS, MoldATSA, ROMATSA and UKSATSE) are higher than the Pan-European system average and in the same order of

magnitude as the unit costs of ANSPs operating in Western European countries where the cost of living is much higher.

Because of their weight in the Pan-European system and their relatively similar operational and economic characteristics (size, scope of service provided, economic conditions, presence of major hubs), the ACE Benchmarking Reports place a particular focus on the results of the five largest ANSPs (ENAI, DFS, DSNA, ENAV and NATS).

Figure 2.12 shows that although the five largest ANSPs operate in relatively similar economic and operational environments, there is a substantial difference (32%) in unit ATM/CNS provision costs, ranging from DFS (€564) to ENAI (€428).

As indicated in Figure 2.12 above, Belgocontrol and LVNL are amongst the ANSPs with the highest unit costs, ranking first and third in 2016. It is noteworthy that although these two ANSPs operate in relatively similar operational (both exclusively provide ATC services in lower airspace) and economic conditions, the unit ATM/CNS provision costs of Belgocontrol have always been higher than those of LVNL in the past five years (+25% on average over 2010-2014). The gap had significantly reduced in 2015 (+13%) but increased again (+21%) in 2016.

It should also be noted that these ANSPs own infrastructure which is made available to MUAC. To better assess the cost-effectiveness of ATM/CNS provided in each of the Four States (Belgium, Germany, the Netherlands, and Luxembourg) national airspaces, MUAC costs and outputs are consolidated with the costs and outputs of the national providers. This adjustment is presented in Figure 2.13 below.

The bottom of Figure 2.13 shows the figures which have been used for this “adjustment”. The costs figures are based on the cost allocation keys used to establish the Four States cost-base, while the flight-hours are based on those controlled by MUAC in the three FIRs (Belgium, Netherlands and Germany).

The top of Figure 2.13 provides a view of this consolidated ATM/CNS provision costs per composite flight-hour in the airspace of Belgium, the Netherlands and Germany (see blue bars).

After this adjustment, the unit costs in Belgium airspace (€529) remain higher (25%) than in the Dutch airspace (€425).

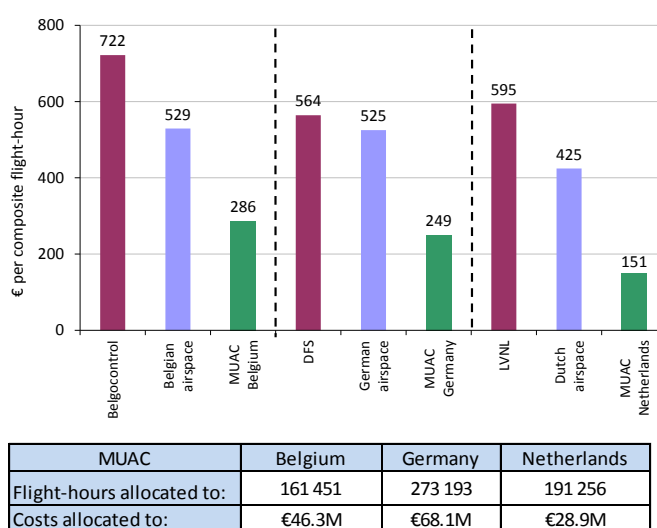


Figure 2.13: Adjustment of the financial cost-effectiveness indicator for ANSPs operating in the Four States airspace, 2016

2.5 Changes in financial cost-effectiveness 2004-2016 and 2015-2016

At Pan-European system level, 2016 ATM/CNS provision costs slightly increased (+0.7%) while composite flight-hours rose by +2.4%. As a result, unit ATM/CNS provision costs reduced by -1.7% in real terms compared to 2015.

Figure 2.14 below provides a long-term trend analysis (2004-2016) showing the changes in traffic, ATM/CNS provision costs and unit costs before and after the 2009 economic crisis. It should be noted that the analysis presented in Figure 2.14 is based on a consistent sample of ANSPs which provided ACE data since 2004, which excludes ARMATS, PANSA, Sakaeronavigatsia and SMATSA.

Figure 2.14 shows that between 2004 and 2016, ATM/CNS provision costs rose by +0.5% p.a. which is significantly less than the +1.5% p.a. increase in traffic. As a result, unit ATM/CNS provision costs per composite flight-hour decreased by -1.0% p.a. on average.

Between 2004 and 2008, a period of sustained traffic growth, the number of composite flight-hours rose faster (+3.8% p.a.) than ATM/CNS provision costs (+2.0% p.a.). As a result, unit ATM/CNS provision costs reduced by -1.8% p.a. over this period. This demonstrated the ability of the ATM industry to reduce unit costs in a context of robust and continuous traffic growth.

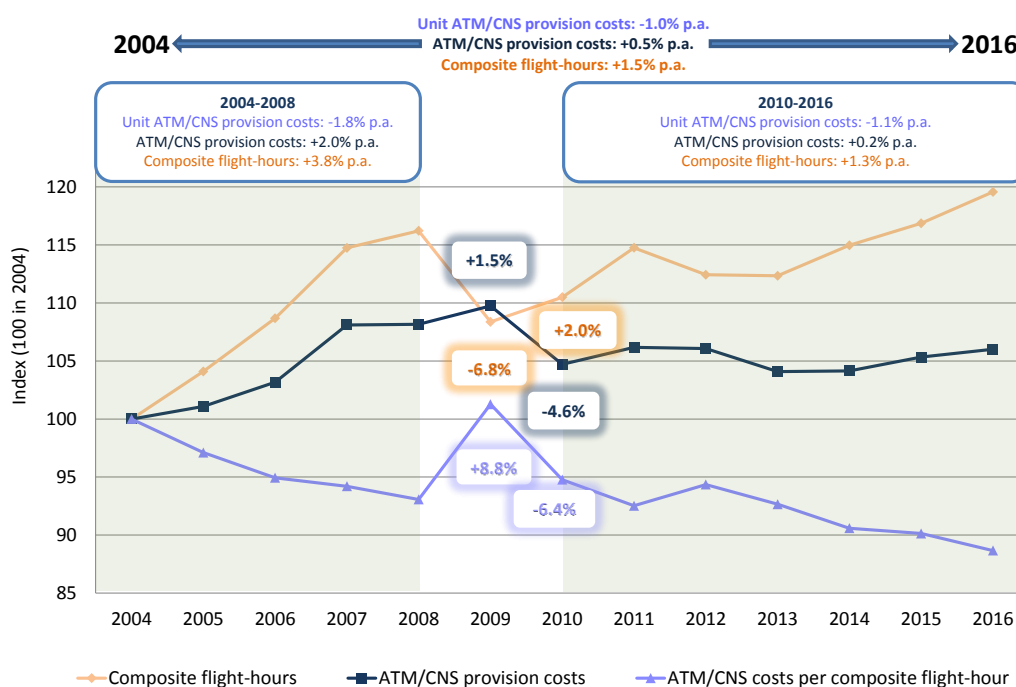


Figure 2.14: Long-term trends in traffic, ATM/CNS provision costs and unit costs

In 2009, following the economic recession traffic fell by -6.8%. In the meantime, ATM/CNS provision costs continued to grow by +1.5%. As a result, unit ATM/CNS provision costs increased by +8.8% and all the cost-effectiveness improvements achieved since 2004 were cancelled out.

In 2010, ATM/CNS provision costs reduced by -4.6% in a context of higher traffic (+2.0%). This performance improvement reflects the impact of the cost containment measures implemented by a majority of ANSPs in the wake of the sharp traffic decrease in 2009.

Between 2010 and 2016, ATM/CNS provision costs remained fairly constant (+0.2% p.a.) in a context of relatively low traffic growth (+1.3% p.a. compared to +3.8% over the 2004-2008 period). As a result, unit ATM/CNS provision costs reduced by -1.1% p.a. between 2010 and 2016. It is interesting to note that after an increase in 2012 (+2.0%), unit ATM/CNS provision costs continuously reduced until 2016 (-1.5% p.a.).

Figure 2.15 below provides a detailed analysis of the changes in cost-effectiveness at ANSP level between 2015 and 2016, identifying the cost and the traffic effects. It shows that in 2016, ATM/CNS provision costs increased for 19 out of 38 ANSPs (top quadrants of Figure 2.15). Although 15 out of these 19 ANSPs experienced traffic increases in 2016, only seven could reduce unit costs (see the green dots on the top right quadrant of Figure 2.15).

In 2016, ATM/CNS provision costs decreased for 19 out of 38 ANSPs (see bottom quadrants of Figure 2.15). For seven ANSPs, the decrease in ATM/CNS provision costs was achieved in a context of traffic reduction (see bottom-left quadrant).

For UkSATSE, traffic significantly fell for the third year in a row (-10.4% in 2016 following -36.1% in 2015 and -36.7% in 2014). These sharp traffic reductions mainly reflects the establishment of restricted/prohibited areas in UkSATSE airspace following the accident of Malaysia Airlines flight MH17 and military conflicts in the Eastern region of Ukraine and the fact that Russian airlines are not allowed anymore to operate to/from Ukrainian airports and to overfly the Ukrainian airspace since the last quarter of 2015. In an attempt to adjust to these unfavourable events, UkSATSE reduced its ATM/CNS provision costs by -18.1% mainly through lower staff costs (-18.7%), cost of capital (-20.9%) and exceptional costs (-84.5%).

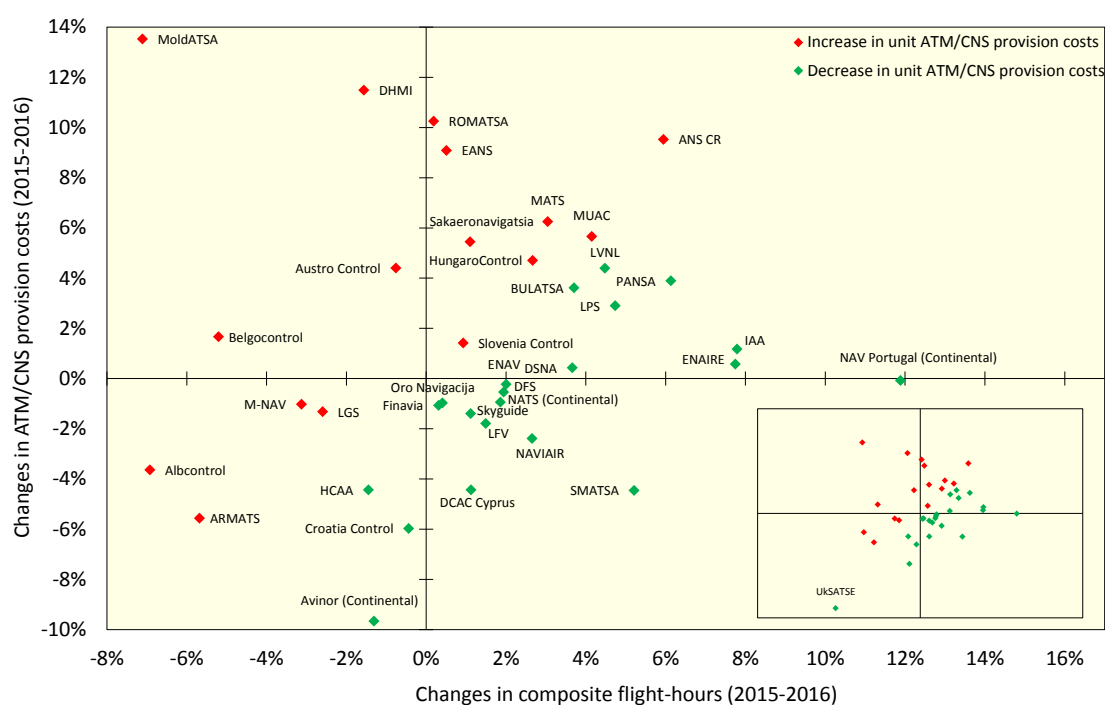


Figure 2.15: Changes in ATM/CNS provision costs and traffic volumes, 2015-2016 (real terms)

In 2016, ATM/CNS provision costs rose by more than +10.0% for three ANSPs: MoldATSA (+13.5%), DHMI (+11.5%) and ROMATSA (+10.3%).

- In the case of MoldATSA, the higher ATM/CNS provision costs reflect the reporting of substantial exceptional costs (€0.8M) which are linked to costs arising from exchange rates fluctuations. It should be noted that the traffic flows controlled by MoldATSA were adversely affected by the situation in Ukraine (-7.1% compared to 2016). As a result, MoldATSA unit costs increased by +22.2% in 2016.
- For DHMI, although an increase can be observed for all the cost categories, the higher ATM/CNS provision costs (+11.5%, or +€48.1M) mainly reflect higher staff costs (+19.1%, or +€33.8M). In 2016, the traffic growth in Turkey was affected by a series of adverse events including several terrorist attacks and a travel ban imposed by the Russian Federation on charter flights until August 2016. As the result, the number of composite flight-hours

controlled by DHMI reduced by -1.6% and its unit ATM/CNS provision costs rose by +13.3% compared to 2015.

- For ROMATSA, the primary driver for the observed increase is higher staff costs (+8.7% or +€9.6M). Significant increases are also observed for exceptional costs (+89.7% or +€4.9M) and non-staff operating costs (+16.2% or +€3.2M). It is understood that the higher exceptional costs reported in 2016 mainly reflect increases in provisions linked to employee benefits. Since in the meantime traffic volumes remained fairly constant (+0.2%), ROMATSA unit ATM/CNS provision costs rose by +10.0% in 2016.

All the five largest ANSPs, DFS (-2.4%), DSNA (-3.1%), ENAIRE¹⁵ (-6.7%), ENAV (-2.2%) and NATS (-2.7%) could achieve reductions in unit ATM/CNS provision costs in 2016. These reductions were achieved in the context of traffic increases for all these ANSPs (ranging from +1.9% for DFS and NATS to +7.7% for ENAIRE).

Overall, for DFS (-0.5%), DSNA (+0.4%), ENAIRE (+0.6%), ENAV (-0.2%) and NATS (-0.9%), 2016 ATM/CNS provision costs remained close to their 2015 levels but these average changes mask different trends for individual cost categories:

- For DFS, the higher staff costs (+0.4% or +€2.7M), depreciation costs (+1.1% or +€1.1M), cost of capital (+7.8% or +€6.7M) and exceptional costs (+3.2% or +€1.5M) were more than compensated by a substantial reduction in non-staff operating costs (-18.2% or -€17.9M). It is understood that that this decrease mainly reflects the benefits of cost containment measures initiated by DFS in 2012 and 2013.
- For DSNA, this reflects slightly higher staff costs (+0.5% or +€4.5M), non-staff operating costs (+0.6% or +€1.4M) and depreciation costs (+6.5% or +€7.6M) while the cost of capital substantially reduced (-16.1% or -€8.1M).
- In the case of ENAIRE, this reflects higher staff costs (+1.7% or +€8.7M), non-staff operating costs (+5.7% or +€4.1M) while depreciation costs (-4.4% or -€4.7M) and the cost of capital (-7.8% or -€3.8M) reduced. It should be noted that the reduction in ENAIRE capital-related costs mainly reflects the results of an optimisation plan associated with the postponement of non-crucial investment projects.
- For ENAV, the decreases in non-staff operating costs (-0.5% or -€0.7M) and depreciation costs (-3.4% or -€4.2M) more than compensated for the higher staff costs (+0.4% or +€1.5M) and cost of capital (+2.7% or +€1.8M). It is understood that the reduction in ENAV depreciation costs is mainly due to the postponement of various investment projects to future years and to savings linked to an activity of pricing negotiation with the suppliers.
- For NATS, the lower staff costs (-0.4% or -€1.6M), non-staff operating costs (-8.3% or -€12.1M), cost of capital (-7.7% or -€5.5M) and exceptional costs (-88.6% or -€6.9M) more than compensated for the increase in depreciation costs (+14.5% or +€18.5M).

More details on the changes in unit ATM/CNS provision costs for individual ANSPs are provided in Part II of this Report.

Figure 2.16 below shows the analytical framework which is used in the ACE analysis to break down the financial cost-effectiveness indicator into basic economic drivers.

¹⁵ ENAIRE 2016 ATM/CNS provision costs comprise costs relating to ATM/CNS infrastructure shared with the military authority (€16.6M), which are charged to civil airspace users. It should be noted that these costs, which are borne by the Spanish Air Force (Ministry of Defence), as well as the corresponding revenues, are not passing through ENAIRE Accounts from 2014 onwards.

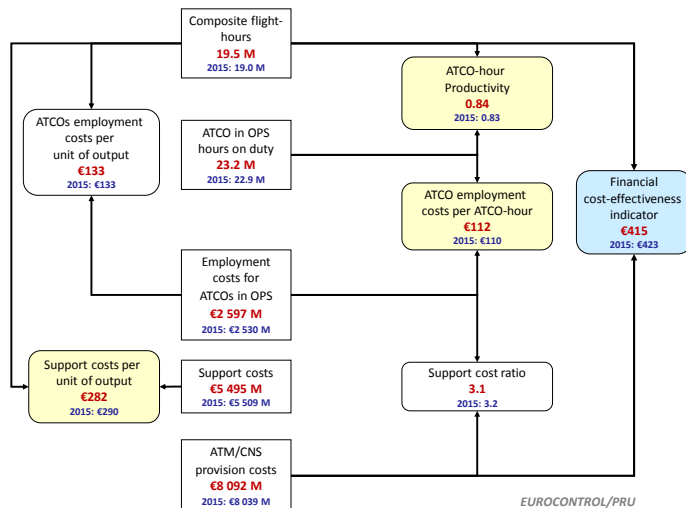


Figure 2.16: ACE performance framework, 2016 (real terms)

Around 32% of ATM/CNS provision costs directly relates to ATCOs in OPS employment costs while 68% relate to “support” functions including non-ATCOs in OPS employment costs, non-staff operating costs and capital-related costs such as depreciation costs and the cost of capital.

Figure 2.17 below shows that between 2015 and 2016, ATCO employment costs per ATCO-hour (+1.4%) and ATCO-hour productivity (+1.2%) rose at a relatively similar pace. As a result, ATCO employment costs per composite flight-hour remained fairly constant (+0.2%). In the meantime, unit support costs fell by -2.6% since the number of composite flight-hours increased (+2.4%) while support costs remained close to 2015 levels (-0.3%). As a result, in 2016 unit ATM/CNS provision costs reduced by -1.7% at Pan-European system level.

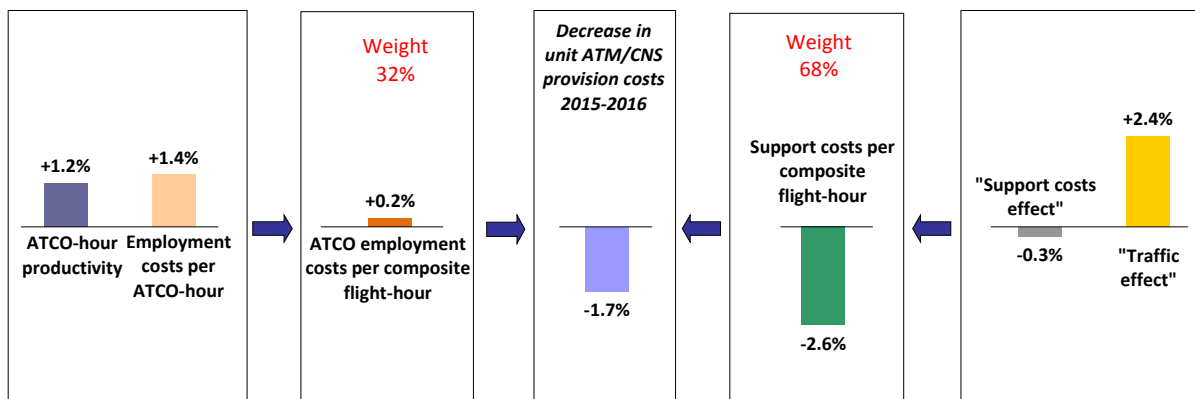


Figure 2.17: Changes in the financial cost-effectiveness indicator, 2015-2016 (real terms)

A detailed analysis of the changes in the key drivers of cost-effectiveness between 2011 and 2016 is provided hereafter (see sections 2.6, 2.7 and 2.8 below).

2.6 ATCO-hour productivity

At Pan-European level, an average of 0.84 composite flight-hour was controlled per ATCO-hour in 2016. ATCO-hour productivity rose by +5.5% between 2011 and 2016 since the increase in traffic (+4.4%) was absorbed with fewer ATCO-hours on duty (-1.0%).

Figure 2.18 indicates that ATCO-hour productivity remained fairly constant in 2012 (+0.1%) and then continuously rose in 2013 (+0.9%), 2014 (+1.9%), 2015 (+1.4%) and 2016 (+1.2%).

ATCO-hour productivity rose by +1.1% p.a. over the 2011-2016 period. As a result, the Pan-European system productivity in 2016 is +5.5% higher than in 2011.

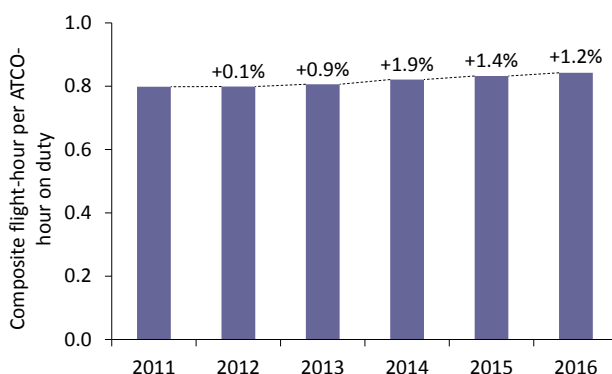


Figure 2.18: Changes in ATCO-hour productivity, 2011-2016

Figure 2.19 shows that over the 2011-2016 period, improvements in ATCO-hour productivity were proportionally higher for ANSPs¹⁶ operating in Central and Eastern European States (see green dots in Figure 2.19). Indeed, ATCO-hour productivity rose by +2.0% p.a. for these ANSPs since 2011.

A robust traffic growth (+2.4% p.a.) significantly contributed to the observed improvement for these ANSPs while the number of ATCO-hours on duty slightly increased (+0.4% p.a. on average).

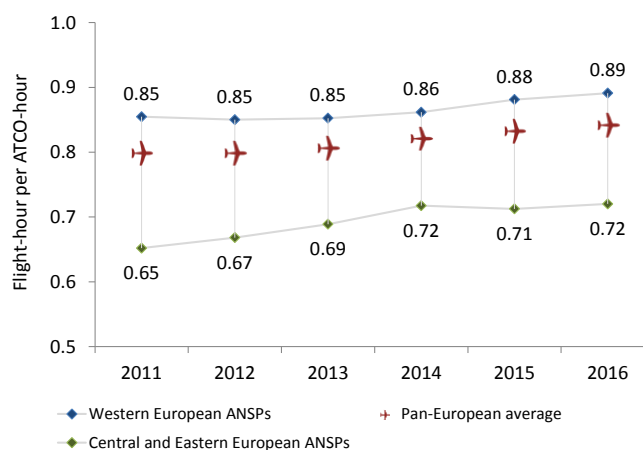


Figure 2.19: Convergence in ATCO-hour productivity levels, 2011-2016

On the other hand, the productivity increase for ANSPs operating in Western European States (see blue dots in Figure 2.19) was much lower (+0.8% p.a.). This mainly reflects the fact that, over the 2011-2016 period, traffic growth was much lower for these ANSPs (+0.4% p.a.) while they could achieve reductions in ATCO-hours on duty (-0.4% p.a.).

Figure 2.19 indicates that the substantial gap in ATCO-hour productivity observed between the two ANSP groups in 2011 (31%) significantly reduced over the years to reach a minimum of 20% in 2014 but increased in 2015 and 2016 at 24%. The increase observed in the recent years mainly reflects a change in traffic growth for the Western European ANSPs. Indeed, after the reduction

¹⁶ Albcontrol, ANS CR, ARMATS, BULATSA, Croatia Control, DCAC Cyprus, DHMI, EANS, HungaroControl, LGS, LPS, MATS, M-NAV, MoldATSA, Oro Navigacija, PANSA, ROMATSA, Slovenia Control, SMATSA and UksATSE. Sakaeronavigatsia is excluded from Figure 2.18 and Figure 2.19 since this ANSP was included from the first time in the ACE benchmarking analysis in 2015.

recorded over the 2011-2014 period (-0.8% p.a.), the number of composite flight-hours controlled by the Western European ANSPs rose by +2.2% p.a. between 2014 and 2016.

In addition, the relatively high traffic growth experienced by the Central and Eastern European ANSPs between 2011 and 2014 (+2.9% p.a.) slowed down in 2015 (+2.5%) and 2016 (+0.7%) mainly reflecting the traffic decreases observed for UkSATSE (since 2014) and DHMI (in 2016).

At Pan-European system level, the increase in productivity achieved between 2015 and 2016 (+1.2%) is due to the fact that traffic rose faster (+2.4%) than ATCO-hours on duty (+1.3%). In order to understand the factors underlying the productivity increase at Pan-European system level, the change in each ANSP's productivity indicator has been broken down in Figure 2.20 below, into a traffic volume effect and an ATCO-hours effect. For presentation purposes, in Figure 2.20, ANSPs have been ranked by their level of productivity in 2016.

ANSPs	ATCO-hour productivity in 2015	(A) Changes in ATCO-hour productivity 2015-2016	(B) "Traffic effect"	(C) "ATCO-hour effect"	ATCO-hour productivity in 2016
MUAC	1.97	3.0%	4.1%	1.1%	2.03
IAA	1.11	5.4%	7.8%	2.3%	1.17
NAV Portugal (Continental)	1.02	13.8%	11.9%	-1.7%	1.17
DFS	1.11	-1.8%	1.9%	3.8%	1.09
NATS (Continental)	1.10	-2.8%	1.9%	4.8%	1.07
DHMI	1.02	-0.1%	-1.6%	-1.5%	1.02
ANS CR	0.96	5.8%	5.9%	0.1%	1.02
Skyguide	0.98	2.5%	1.1%	-1.3%	1.01
NAVIAIR	1.00	-0.2%	2.7%	2.9%	1.00
HungaroControl	0.93	6.7%	2.7%	-3.7%	0.99
PANSA	0.89	5.3%	6.1%	0.8%	0.94
Austro Control	0.92	-0.6%	-0.8%	-0.1%	0.91
EANS	0.91	-2.1%	0.5%	2.6%	0.89
DCAC Cyprus	0.87	1.3%	1.1%	-0.2%	0.88
MATS	0.83	5.3%	3.0%	-2.2%	0.88
Avinor (Continental)	0.93	-8.3%	-1.3%	7.6%	0.85
ENAIRES	0.79	6.2%	7.7%	1.5%	0.84
SMATSA	0.74	11.7%	5.2%	-5.8%	0.83
BULATSA	0.82	1.0%	3.7%	2.6%	0.83
LPS	0.77	3.0%	4.7%	1.6%	0.79
LGS	0.88	-10.6%	-2.6%	9.0%	0.78
ENAV	0.72	7.4%	2.0%	-5.0%	0.77
DSNA	0.77	-1.1%	3.7%	4.9%	0.76
LVNL	0.78	-4.2%	4.5%	9.1%	0.75
HCAA	0.74	-0.2%	-1.4%	-1.2%	0.73
ROMATSA	0.69	4.2%	0.2%	-3.9%	0.72
Croatia Control	0.73	-1.9%	-0.4%	1.5%	0.71
LFV	0.69	3.8%	1.5%	-2.2%	0.71
Belgocontrol	0.70	-2.3%	-5.2%	-3.0%	0.68
Finavia	0.62	0.4%	0.3%	-0.1%	0.62
Oro Navigacija	0.49	4.4%	0.4%	-3.8%	0.51
Albcontrol	0.45	4.9%	-6.9%	-11.2%	0.47
Slovenia Control	0.45	1.4%	0.9%	-0.5%	0.46
Sakaeronavigatsia	0.49	-8.0%	1.1%	-9.9%	0.45
M-NAV	0.36	-20.0%	-3.1%	21.1%	0.29
UkSATSE	0.17	-12.1%	-10.4%	1.9%	0.15
ARMATS	0.14	-1.7%	-5.7%	-4.1%	0.14
MoldATSA	0.15	-10.6%	-7.1%	4.0%	0.14
Total Pan-European System	0.83	1.2%	2.4%	1.3%	0.84

Positive values in column (A) mean that productivity improved between 2015 and 2016.

Positive values in column (B) mean that traffic volumes rose between 2015 and 2016.

Positive values in column (C) mean that the number of ATCO-hours rose between 2015 and 2016. All other things being equal, a positive value contributes to lower productivity (hence the red dot).

Productivity improves if traffic grows faster than the ATCO-hours on duty.

For example: DFS's 2016 productivity is -1.8% lower than in 2015 since the number of ATCO-hours rose faster (+3.8%) than composite flight-hours (+1.9%).

Note: By mathematical construction, the % variation in productivity (A) can be approximated as the difference between the "traffic effect" (B) and the "ATCO-hour effect" (C). The larger the % variations, the less accurate the approximation. This explains why in some cases (A) is not exactly equal to (B) - (C).

Figure 2.20: Annual changes in ATCO-hour productivity, composite flight-hours and ATCO-hours on duty, 2015-2016

For the sake of completeness, Figure 2.20 also shows the starting point in 2015. This allows for a better interpretation of the changes in ATCO-hour productivity observed in 2016.

This table suggests that the largest increases in productivity are likely to arise from serving increased traffic with the same or a reduced number of ATCOs, although in some of the cases the number of ATCO-hours has risen, but not as fast as traffic growth.

Changes in ATCOs in OPS hours on duty could arise from:

- Changes in the number of FTE ATCOs in OPS (caused by such factors as newly licensed ATCOs, normal retirement, activation of an early retirement scheme);
- Changes in the number of hours on duty, through:
 - Modification of the contractual working hours following a new labour agreement;
 - Changes in the number of hours not on duty (for example, through an increase in average sickness or in refresher training time); or,
 - Changes in overtime (where applicable).

In 2016, the ATCO-hour productivity¹⁷ of the Pan-European system as a whole amounted to 0.84 composite flight-hours per ATCO-hour. It is important to note that the metric of ATCO-hour productivity used in this report reflects the average productivity during a year for a given ANSP and does not give an indication of the productivity at peak times which can be substantially higher. The ATCO-hour productivity in 2016 for each ANSP is shown in Figure 2.21 below.

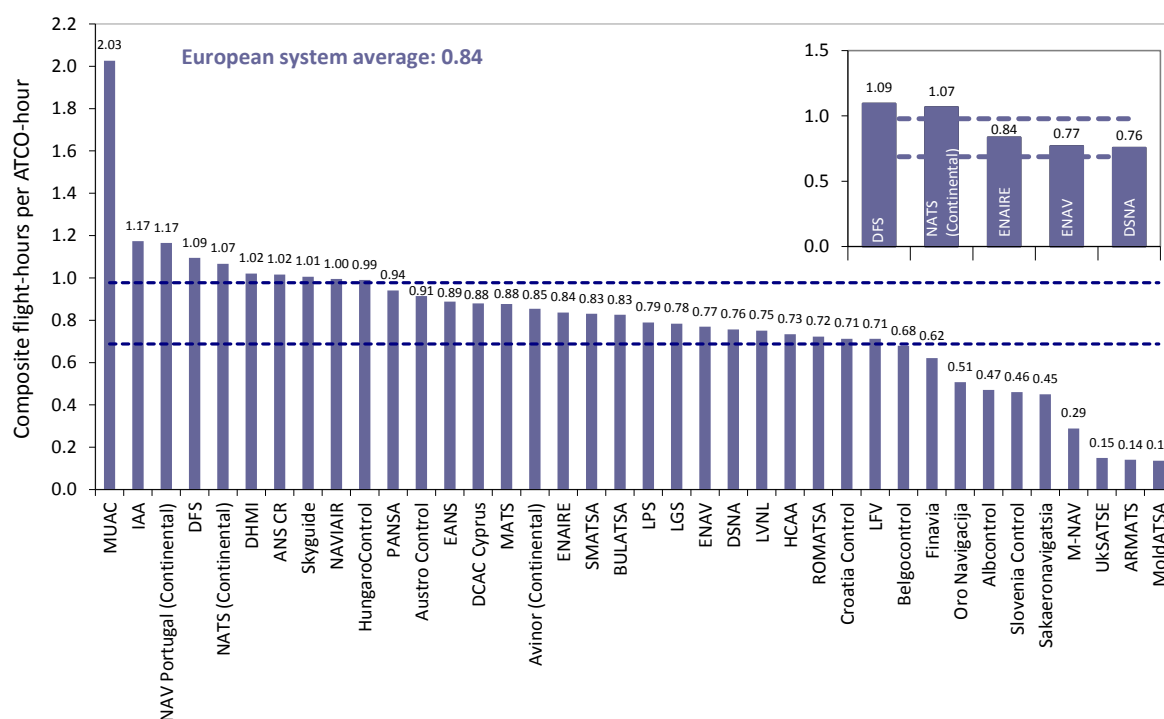


Figure 2.21: ATCO-hour productivity (gate-to-gate), 2016

There is a wide range of ATCO-hour productivity among ANSPs. The ANSP with the highest ATCO-hour productivity in 2016 is MUAC (2.03), which only provides ATC services in upper airspace, while the ANSPs with the lowest ATCO-hour productivity are ARMATS and MoldATSA (both at 0.14), i.e. two of the smallest ANSPs in terms of traffic volumes.

Figure 2.21 also indicates that there are substantial differences in ATCO-hour productivity even among the five largest ANSPs. Indeed, DFS ATCO-hour productivity (1.09) is +44.7% higher than that of DSNA (0.76).

¹⁷ It should be noted that the ACE benchmarking analysis focuses on IFR traffic and that it does not reflect the activity associated with the provision of ANS to VFR flights.

It is important to mention that significant gains in cost-effectiveness could be achieved if the European average productivity (0.84) was raised to the level of the top quartile in Figure 2.21 (0.98). Most of the ANSPs that achieve or are close to top quartile ATCO-hour productivity (e.g. ANS CR, DFS, DHMI, MUAC, NATS and Skyguide) are among the ANSPs with the most complex traffic. On the other hand, ARMATS, MoldATSA and UksATSE, which belong to the ANSPs with the least complex traffic (see Figure 2.2) show an ATCO-hour productivity which is substantially lower than the bottom quartile (0.69). Low productivity in some of these ANSPs may be a consequence of their small size, and the difficulty in adapting their available ATC capacity and existing infrastructure to low traffic volumes and high seasonal variability. In the case of ARMATS, MoldATSA and UksATSE, the substantial traffic decreases experienced in 2016 (-5.7%, -7.1% and -10.4%, respectively) had a massive adverse impact on ATCO productivity.

Improvements in ATCO-hour productivity can result from more effective OPS room management and by making a better use of existing resources, for example through the adaptation of rosters (preferably individually-based to enhance flexibility) and shift times, effective management of overtime, and through the adaptation of sector opening times to traffic demand patterns. Similarly, advanced ATM system functionalities and procedures are drivers for productivity improvements. It is also expected that SES tools such as FABs, the Network Manager, the Performance Scheme and the technological pillar (SESAR) contribute to increase ATCO productivity by a significant factor while ensuring safety standards.

More details on the changes in ATCO-hour productivity for individual ANSPs are provided in Part II of this Report.

ATCO-hour productivity measured at ANSP level reflects an average performance, which can hide large differences among ACCs even for those operating in the same country/ANSP. It is therefore important to also analyse and compare productivity at ACC level.

In Figure 2.22, the 63 ACCs for which ACE 2016 data were reported are grouped in clusters based on three operational characteristics: (1) their complexity scores, (2) the average used flight levels, and (3) their number of sectors. More information on the definition of these clusters can be found in previous ACE reports¹⁸.

So far, no clear-cut statistical relationship between ATCO productivity, traffic complexity and traffic variability could be inferred because the relationships and potential trade-offs between all these metrics are not straightforward. Nevertheless, it is useful to compare the ATCO productivity of ACCs that share similar “operational” characteristics. Each cluster is briefly described below:

- **Cluster 1 (ACCs serving predominantly lower airspace with relatively high structural complexity)** has the second lowest average productivity of the four clusters (0.83 flight-hour per ATCO-hour). Istanbul which was in previous ACE reports part of Cluster 3a is now part of Cluster 1. Indeed, following a reorganisation of the Turkish airspace, Istanbul ACC provides ATC services in lower airspace (i.e. up to FL245). Palma, with the lowest productivity, has one of the highest seasonal traffic variability in Cluster 1.
- **Cluster 2 (ACCs serving dense upper airspace)** has an average productivity of 1.28 flight-hour per ATCO-hour. Within this cluster, Maastricht continues to have significantly higher productivity (2.03 flight-hours per ATCO-hour, some +58% above the average in Cluster 2). When excluding Maastricht and Karlsruhe ACCs which exclusively provide ATC services in

¹⁸ See for example the ACE 2008 Benchmarking Report on p.104. Report available on the PRC website: (<http://www.eurocontrol.int/prc/publications>).

upper airspace, the average cluster productivity falls to 1.16. It should be noted that Brest and Bordeaux ACCs are now part of Cluster 2 since their aggregated complexity score (7.1 and 7.4 respectively) is higher than the Pan-European average (6.0 at ACC level).

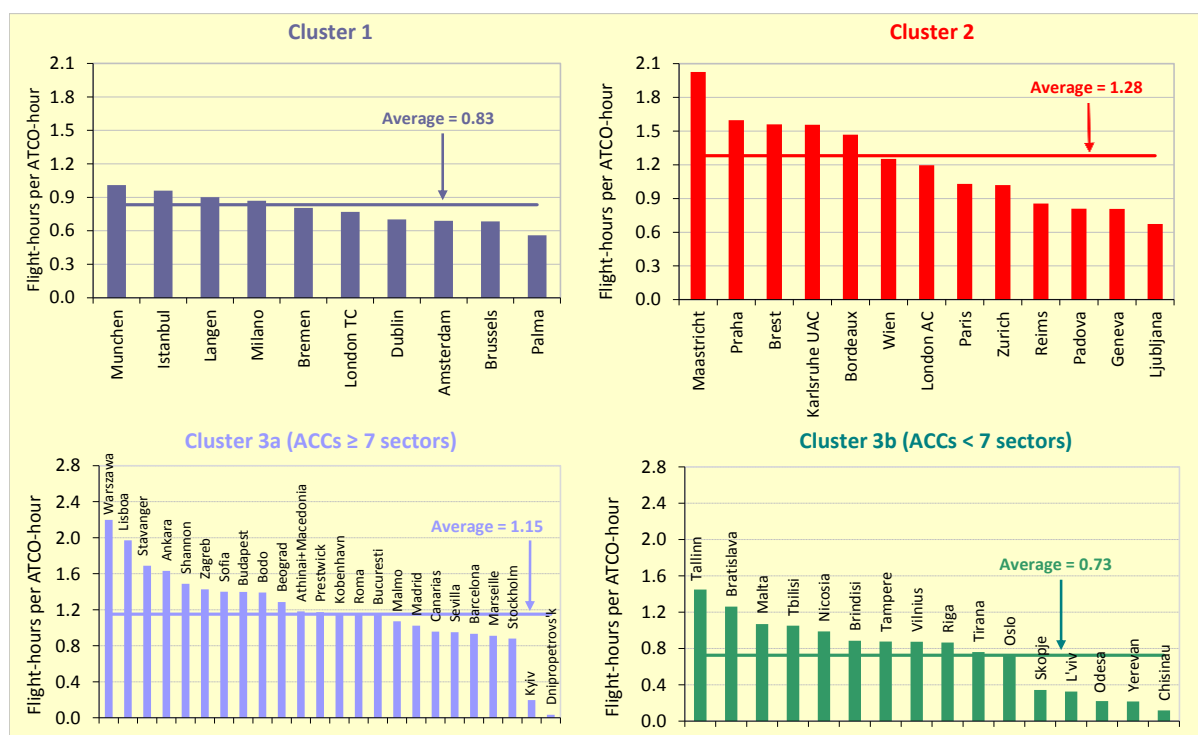


Figure 2.22: Summary of productivity results at ACC level, 2016

- **Cluster 3a (ACCs with 7 sectors or more and serving airspace with relatively lower complexity)** has an average productivity of 1.15 flight-hour per ATCO-hour. Within this cluster, Warszawa has the highest productivity (2.20 flight-hours per ATCO-hour). It should also be noted that Bodo and Dnipropetrovsk ACCs are now part of Cluster 3a since these ACCs opened 7 sectors at maximum configuration in 2016.
- **Cluster 3b (ACCs with less than 7 sectors serving airspace with relatively lower complexity)** has an average productivity of 0.73 flight-hour per ATCO-hour. It is important to note that Chisinau ACC, which has the lowest ATCO-hour productivity, experienced substantial traffic decreases in the previous years mainly due to changes in traffic flows following the closure of a part of airspace over Ukraine.

The analysis of ATCO-hour productivity at ACC level would seem to indicate that, whilst complexity measures are helpful in providing a way of clustering ACCs into broadly consistent groups, within these clusters there are still large differences in productivity performance across individual ACCs.

Other factors as yet unidentified (and not measured) such as the impact of different operational concepts and processes, the operational flexibility, could also affect ATCO productivity performance. There may also be cultural and managerial differences. These elements would deserve further analysis in order to provide further insight on the differences in ATCO-productivity and identify best practice.

2.7 ATCO employment costs

At Pan-European system level, ATCO employment costs per ATCO-hour increased between 2011 and 2016 (an average of +1.4% p.a.). As a result, in 2016 ATCO employment costs per ATCO-hour are +7.1% higher than in 2011.

Figure 2.23 shows that employment costs per ATCO-hour continuously rose over the 2011-2016 period. At the exception of 2015 (+1.9%), these annual increases ranged between +1.1% and +1.4%.

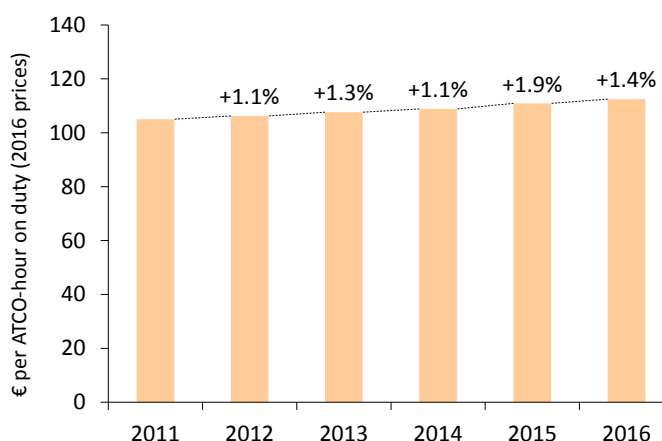


Figure 2.23: Changes in ATCO employment costs per ATCO-hour¹⁹, 2011-2016 (real terms)

In 2016, ATCO employment costs per ATCO-hour rose for 25 out of the 38 ANSPs. Significant increases were observed for some ANSPs. This was the case for LVNL (+19.6% from €116 to €139), DHMI (+17.6% from €54 to €63), Sakaeronavigatsia (+12.6% from €20 to €23), ANS CR (+12.5% from €89 to €101) and Belgocontrol (+11.1% from €141 to €157).

Among the five largest ANSPs, the most noticeable increase in ATCO employment costs per ATCO-hour in 2016 was observed for ENAV (+5.2%, from €114 to €120). This increase mainly reflects a substantial reduction of ATCO-hours on duty (-5.0%) while ENAV ATCOs in OPS employment costs remained fairly constant in 2016.

A smaller increase was observed for DSNA (+0.9%, from €100 to €101), while employment costs per ATCO-hour fell for DFS (-1.3%, from €228 to €225), ENAIRE (-1.8%, from €166 to €163) and NATS (-7.6%, from €144 to €133). The significant decrease observed for NATS reflects the combination of higher ATCO-hours on duty (+4.8%) and lower ATCOs in OPS employment costs (-3.2%).

As a consequence of these changes, the gap between DFS and DSNA in terms of employment costs per ATCO-hour slightly reduced in 2016 but remains significant, i.e. a factor of 2.2 (compared to 2.3 in 2015).

Overall, decreases in ATCO employment costs per ATCO-hour are observed for 13 ANSPs in 2016. This was for example the case of UKSATSE (-8.4%, from €12 to €11), and M-NAV (-5.2% from €43 to €41).

The unit ATCO employment costs at Pan-European system level amounted to €112 per ATCO-hour in 2016. Figure 2.24 shows the values for this indicator for all the ANSPs. There is a wide range of ATCO-hour employment costs across ANSPs, which is not surprising given the heterogeneity in the social and economic environments across Europe.

In 2016, DFS ATCO employment costs per ATCO-hour (€225) are the highest in Europe, above MUAC (€216) and Skyguide (€184).

¹⁹ It should be noted that since Sakaeronavigatsia was included in the benchmarking analysis for the first time in ACE 2015, the analysis of the changes in ATCO employment costs per ATCO-hour presented in Figure 2.23 is made on a sample excluding the Georgian ANSP.

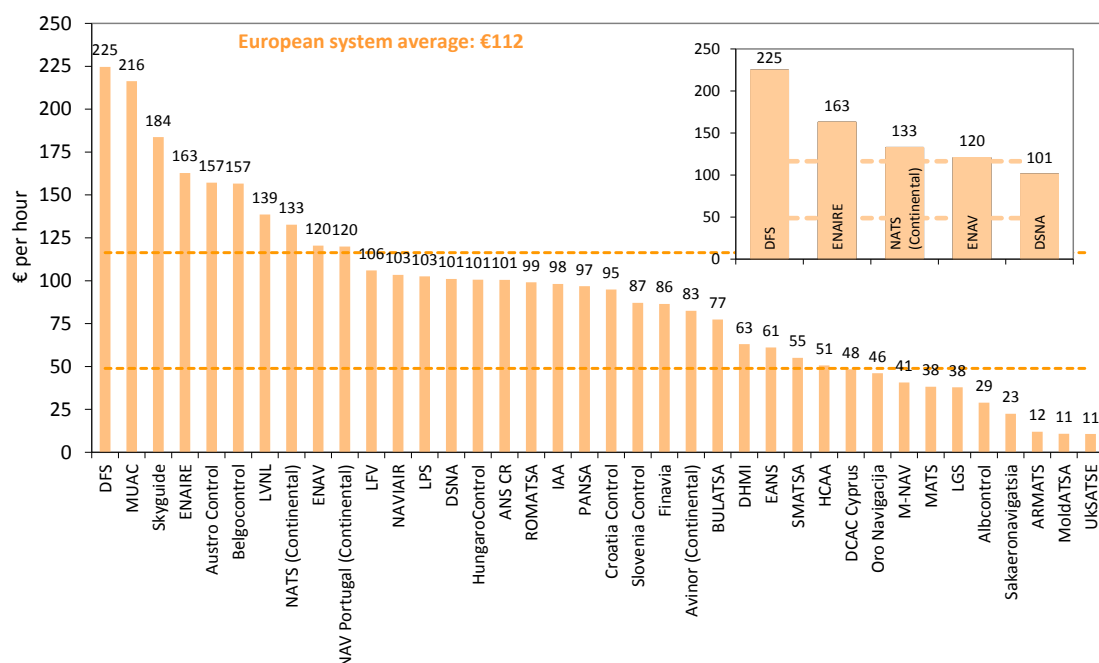


Figure 2.24: ATCO employment costs per ATCO-hour (gate-to-gate), 2016

A major exogenous factor that underlies differences in unit employment costs is the difference in prevailing market wage rates in the national economies in general. This is also associated with differences in the cost of living. To assess the influence of these exogenous differences, employment costs per ATCO-hour have also been examined in the context of Purchasing Power Parity (PPP). The PPPs for 2016, which are available from the EUROSTAT and IMF databases, are reported for each State/ANSP in Annex 7 of this report.

Figure 2.25 below shows the ATCO employment costs per ATCO-hour both **before** and **after** adjustment for PPP. The adjustment reduces the dispersion of this indicator.

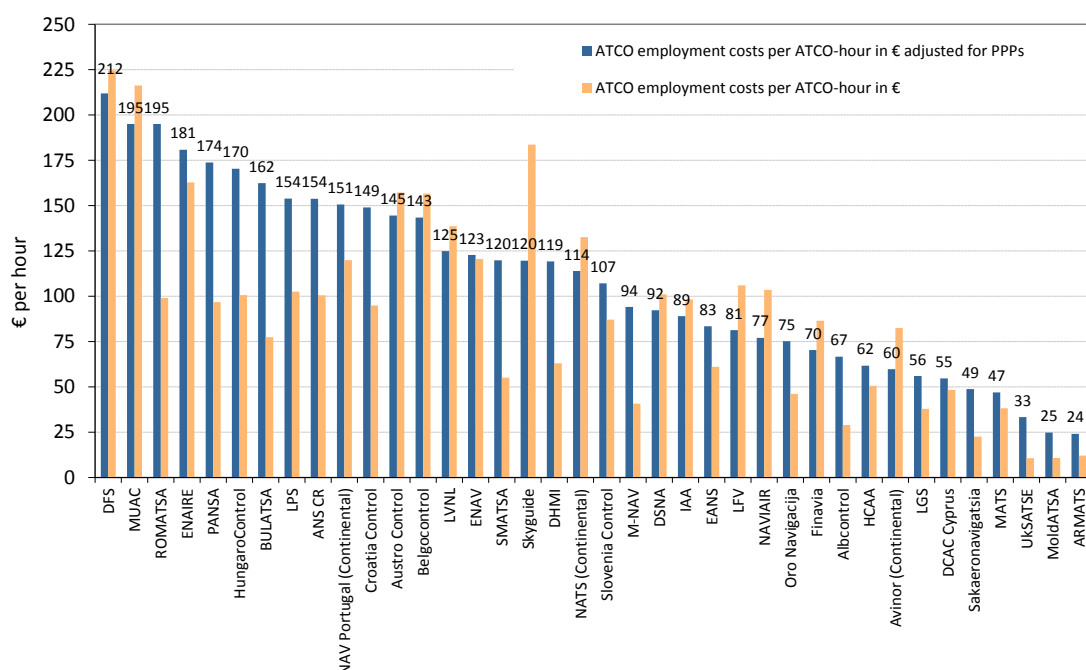


Figure 2.25: Employment costs per ATCO-hour with and without PPPs, 2016

After PPP adjustment, the average unit employment costs per ATCO-hour amounts to €121 (compared to €112 without adjustment). For many Central and Eastern European ANSPs (e.g. ANS CR, BULATSA, Croatia Control, HungaroControl, LPS, PANSa and ROMATSA) the PPP adjustment brings the unit employment costs close or higher than those operating in Western Europe.

There are some limitations²⁰ inherent to the use of PPPs and for this reason the ACE data analysis does not put a significant weight on results obtained with PPPs adjustments. PPPs are nevertheless a useful analytical tool in the context of international benchmarking.

Figure 2.26 below shows the ATCO employment costs per composite flight-hour in 2016. This indicator results from the combination of two of the main components of the financial cost-effectiveness indicator: the ATCO-hour productivity (see Figure 2.21) and employment costs per ATCO-hour (see Figure 2.24). All other things being equal, lower ATCO employment costs per unit of output will contribute to greater financial cost-effectiveness.

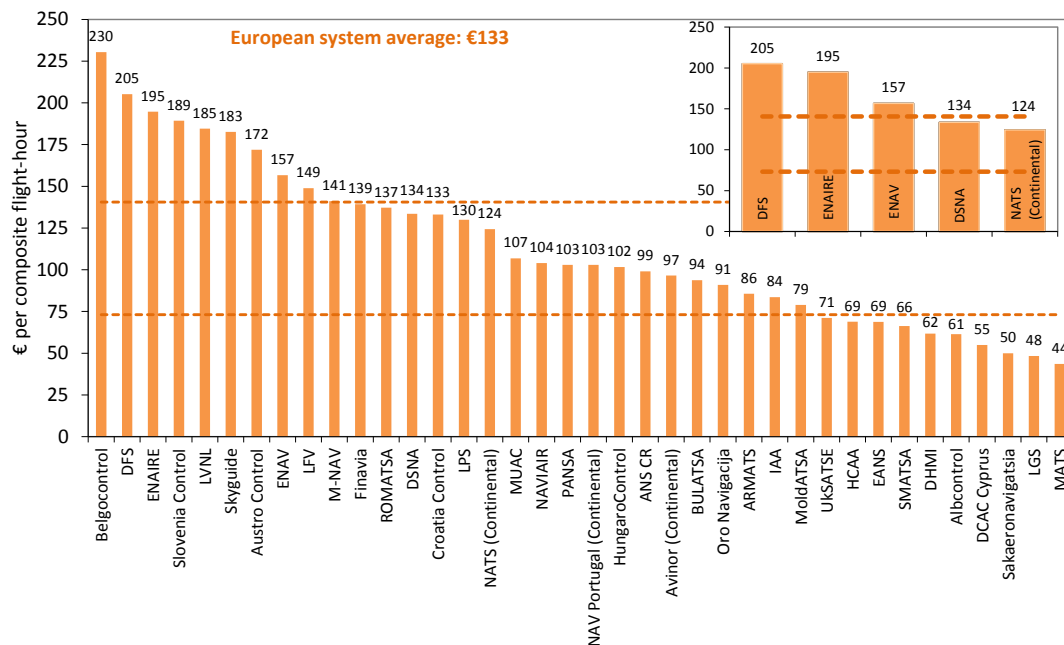


Figure 2.26: ATCO employment costs per composite flight-hour, 2016

In order to provide an insight into the relationship between ATCO-hour productivity and employment costs, Figure 2.27 below presents the ANSPs classified in four quadrants according to their level of ATCO productivity and employment costs per ATCO-hour. The quadrants are established on the basis of the European average values for these two metrics.

An ANSP may have high ATCO employment costs per ATCO-hour but if its ATCOs are highly productive then it will have relatively lower employment costs per composite flight-hour. This is typically the case of MUAC (Quadrant II in Figure 2.27) which shows ATCO employment costs per ATCO-hour above the European average but ATCO employment costs per composite flight-hour below the European average (see also Figure 2.26 above).

²⁰ For instance, it is possible that, for a given country, the cost of living in regions where the ANSP headquarter and other main buildings (e.g. ACCs) are located is higher than the average value computed at national level.

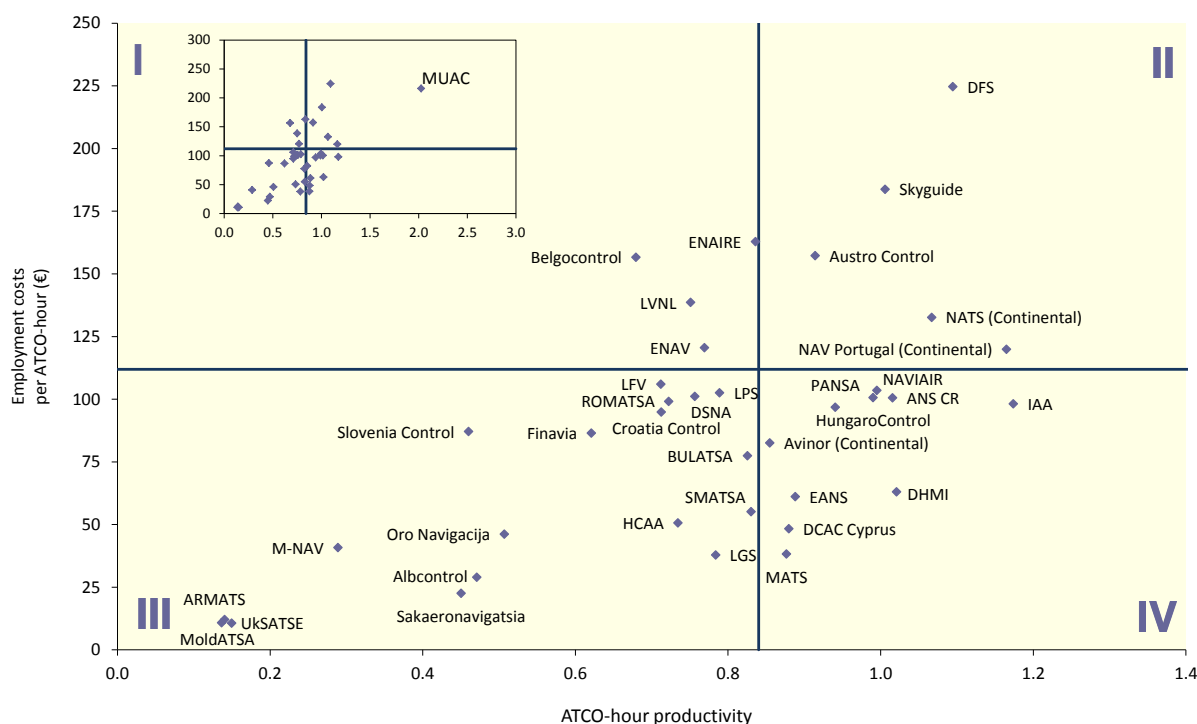


Figure 2.27: Components of ATCO employment costs per unit of output, 2016

Belgocontrol (Quadrant I) combines higher ATCO employment costs with relatively lower ATCO productivity, resulting in higher ATCO employment costs per composite flight-hour (see also Figure 2.26 above).

Some ANSPs such as DHMI (Quadrant IV) have relatively higher ATCO-hour productivity and lower ATCO employment costs per ATCO-hour (without PPP adjustment).

Finally, ANSPs such as ARMATS, MoldATSA and UksATSE (Quadrant III) show both lower ATCO-hour productivity and lower ATCO employment costs per ATCO-hour.

Employment costs are typically subject to complex bargaining agreements between ANSPs management and staff which usually are embedded into a collective agreement. The duration of the collective agreement, the terms and methods for renegotiation greatly vary across ANSPs. In some cases salary conditions are negotiated every year. High ATCO employment costs may be compensated for by high productivity (e.g. MUAC). Therefore, in the context of staff planning and contract renegotiation, it is important for ANSPs to manage ATCOs employment costs effectively and to set quantitative objectives for ATCO productivity.

More details on the changes in ATCO-hour employment costs for individual ANSPs are provided in Part II of this Report.

2.8 Support costs

In 2016, at Pan-European level, unit support costs fell by -2.6% since traffic rose by +2.4% while support costs remained fairly constant (-0.3%). As a result, unit support costs reduced for the fourth consecutive year in 2016 and are -6.8% lower than in 2011.

As indicated in Figure 2.28, support costs per composite flight-hours fell by -6.8% between 2011 and 2016 at Pan-European system level (or -1.4% p.a.). This results from the combination of an increase in the number of composite flight-hours (+0.9% p.a.) and a slight decrease in support costs (-0.5% p.a.).

In 2016, unit support costs decreased for the fourth consecutive year (-2.6% after -1.1% in 2015, -2.3% in 2014 and -2.9% in 2013).

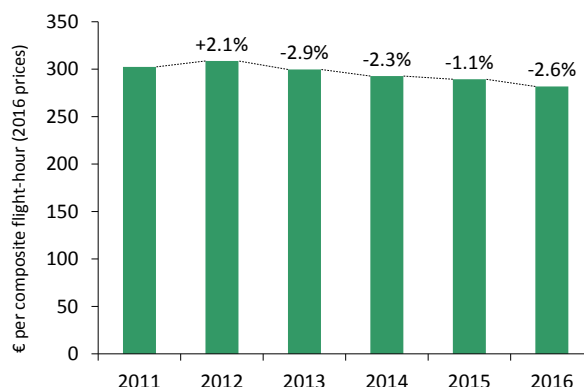


Figure 2.28: Changes in support costs per composite flight-hour, 2011-2016 (real terms)

The main drivers of the changes in support costs are further discussed in Figure 2.30 below.

Contrary to ATCO employment costs, support costs encompass a variety of cost items which require specific analysis. There is a general acknowledgement that the Pan-European system has excessive support costs due to its high level of operational, organisational, technical and regulatory fragmentation.

As shown in Figure 2.29 below, support costs can be broken down into four separate components that provide further insight into the nature of support costs:

- a) **Employment costs for non-ATCO in OPS staff** (48.6% of total support costs); these cover ATCOs on other duties, trainees, technical support and administrative staff. These costs can be affected by the following factors:
 - Outsourcing of non-core activities (such as maintenance of technical equipment, and professional training) could transfer costs from this category to non-staff costs.
 - Research & development policies may involve ATM systems either being developed in-house, or purchased off-the-shelf. In principle, either solution could lead to the most cost-effective outcome, depending on circumstances; this would depend on whether there were, for example, significant economies of scale, or major transaction costs.
 - Arrangements relating to the collective agreement and the pension scheme for non-ATCOs in OPS.
- b) **Non-staff operating costs** (23.6% of total support costs) mostly comprise expenses for energy, communications, contracted services, rentals, insurance, and taxes. These costs can be affected by the following factors:
 - The terms and conditions of contracts for outsourced activities.
 - Enhancement of the cooperation with other ANSPs to achieve synergies in the context of a FAB (sharing training of ATCOs, joint maintenance, and other matters).
- c) **Capital-related costs** (26.3% of total support costs), comprising depreciation and financing costs for the capital employed. These costs can be affected by the following factors:
 - The magnitude of the investment programme.
 - The accounting life of the assets.
 - The degree to which assets are owned or rented.
- d) **Exceptional costs** represented some 1.5% of total support costs in 2016.

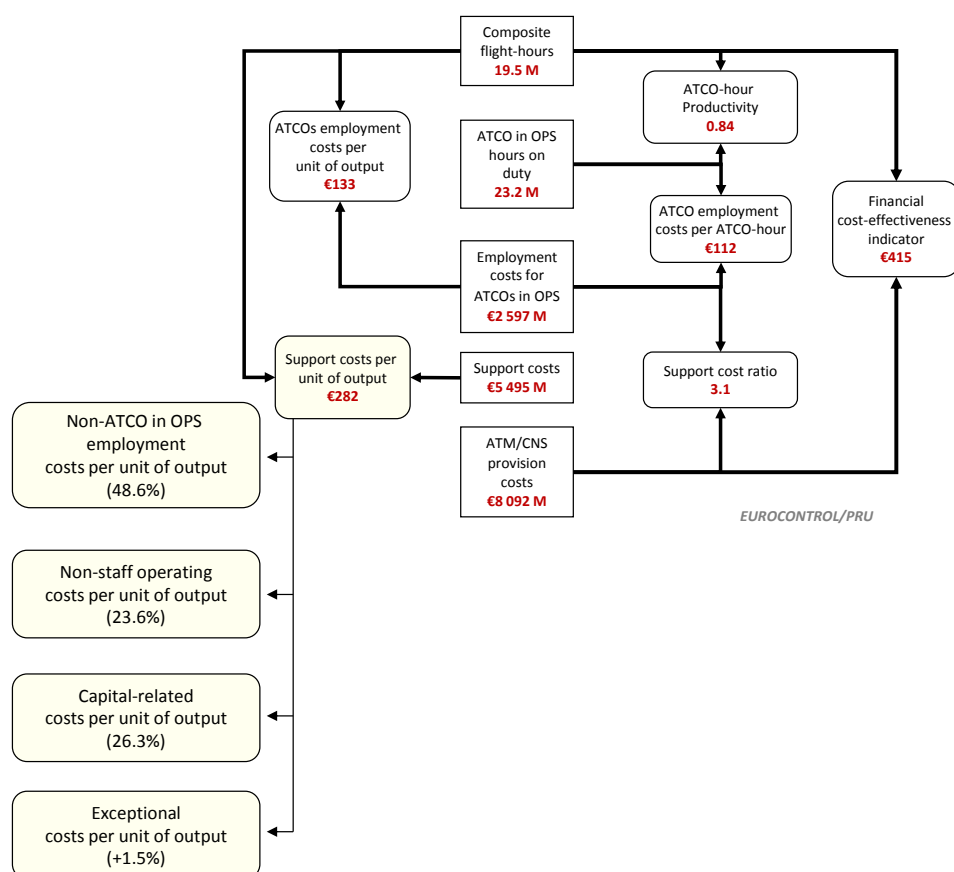


Figure 2.29: Framework for support costs analysis, 2016

Figure 2.30 shows the changes in the different components of support costs (see the “support costs effect” bar on the right-hand side of Figure 2.17) between 2015 and 2016.

Overall, support costs remained relatively close to their 2015 levels (-0.3% or -€14.5). Figure 2.30 indicates that this overall trend masks changes in individual costs categories. Indeed, higher depreciation costs (+2.0% or +€18.8M) were more than compensated by lower non-staff operating costs (-1.9% or -€25.7M) and cost of capital (-2.2% or -€11.2M).

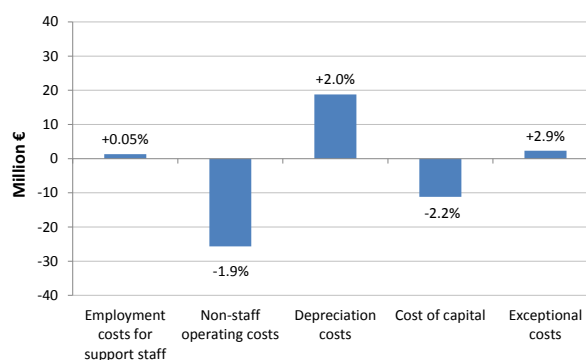


Figure 2.30: Changes in the components of support costs, 2015-2016 (real terms)

In the meantime, support staff costs (+0.05% or +€1.3M) remained fairly constant while exceptional costs were +2.9% (or +€2.3M) higher.

In 2016 support costs rose for 18 out of 38 ANSPs, with particularly large increases observed for DHMI (+10.4% or +€34.7M, mainly reflecting higher support staff costs) and ROMATSA (+12.6% or +€13.4M, mainly due to higher support staff costs, non-staff operating costs and exceptional cost items).

On the other hand, support costs decreased for 20 ANSPs including Avinor (-14.3% or -€18.0M), DFS (-2.2% or -€15.6M), UksATSE (-20.1% or -€15.2M) and DSNM (-1.7% or -€15.1M).

The reduction in Avinor support cost between 2015 and 2016 mainly reflects a significant decrease in support staff costs (-15.0%) and substantially lower non-staff operating costs (-18.9%) compared to 2015. It is understood that these decreases mainly reflect the outcome of a cost-saving programme implemented by Avinor.

In the case of UKSATSE, the main drivers for the observed decrease are a reduction in support staff costs (-22.4%) as well as very large decreases in the cost of capital (-20.9%) and in exceptional costs (-84.5%). These reductions should be seen in the light of the measures implemented by UKSATSE to adapt to the sharp decreases in traffic experienced since 2013 (-63.8%).

For DSN, the main drivers of the decrease in support costs are lower support staff costs (-3.3%) and cost of capital (-16.1%). The latter mainly reflects the fact that a lower interest rate and a lower asset base have been used to compute the cost of capital in 2016.

At Pan-European system level, support costs per composite flight-hour amounted to €282 in 2016. Figure 2.31 shows that the level of unit support costs varies significantly across ANSPs – a factor greater than four between Skyguide (€507) and MUAC (€122).

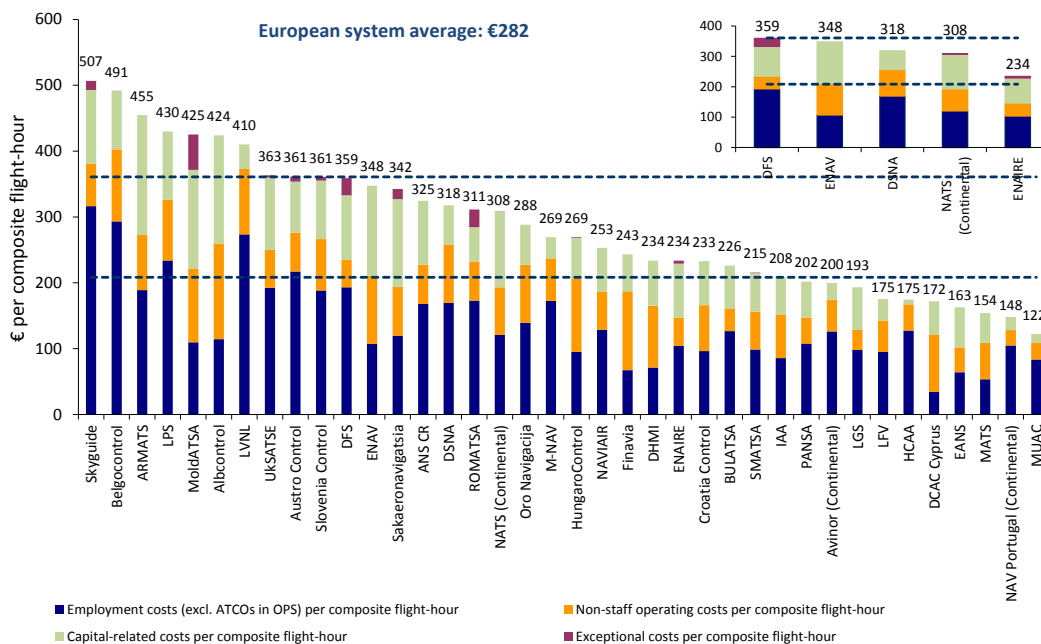


Figure 2.31: Support costs per composite flight-hour at ANSP level²¹, 2016

As for the cost-effectiveness indicator, for ANSPs operating outside the Euro zone, substantial changes of the national currency against the Euro may significantly affect the level of unit support costs. A detailed analysis of the impact of the changes in exchange rates on the level of ANSPs 2016 unit costs is available in Annex 7.

Figure 2.31 indicates that there are significant differences in the composition of support costs amongst the 38 ANSPs, and in particular in the proportion of employment costs (blue bar) and non-staff operating costs (orange bar). The choice between providing some important operational support functions internally or externally has clearly an impact on the proportion of support costs that is classified as employment costs, non-staff operating costs, or capital-related costs. In some

²¹ It should be noted that the cost of capital reported by ANS CR in its 2016 data submission is higher than the costs charged to airspace users. Indeed ANS CR did not charge any cost of capital to terminal ANS users. Similarly, the cost of capital reported by MoldATSA for the purposes of the ACE benchmarking analysis is higher than the amount charged to airspace users.

cases, the maintenance of ATM systems is outsourced and the corresponding costs are reported as non-staff operating costs. For other ANSPs, these activities are rather carried out by internal staff and the related costs appear as employment costs or as capital-related costs when, according to IFRS, the employment costs of staff working on R&D projects can be capitalised in the balance-sheet.

Figure 2.31 also indicates that in 2016 the unit support costs of various ANSPs operating in Central and Eastern European countries (e.g. Albcontrol, ANS CR, ARMATS, LPS, MoldATSA, Sakaeronavigatsia, Slovenia Control and UksATSE) are higher than the Pan-European system average and in the same order of magnitude as the unit support costs of ANSPs operating in Western European countries where the cost of living is much higher.

Like ATCO in OPS employment costs, employment costs for the support staff are also affected by the cost of living. Using the same methodology as in Figure 2.25, Figure 2.32 shows the impact of adjusting the non-ATCO in OPS employment costs per composite flight-hour for PPPs.

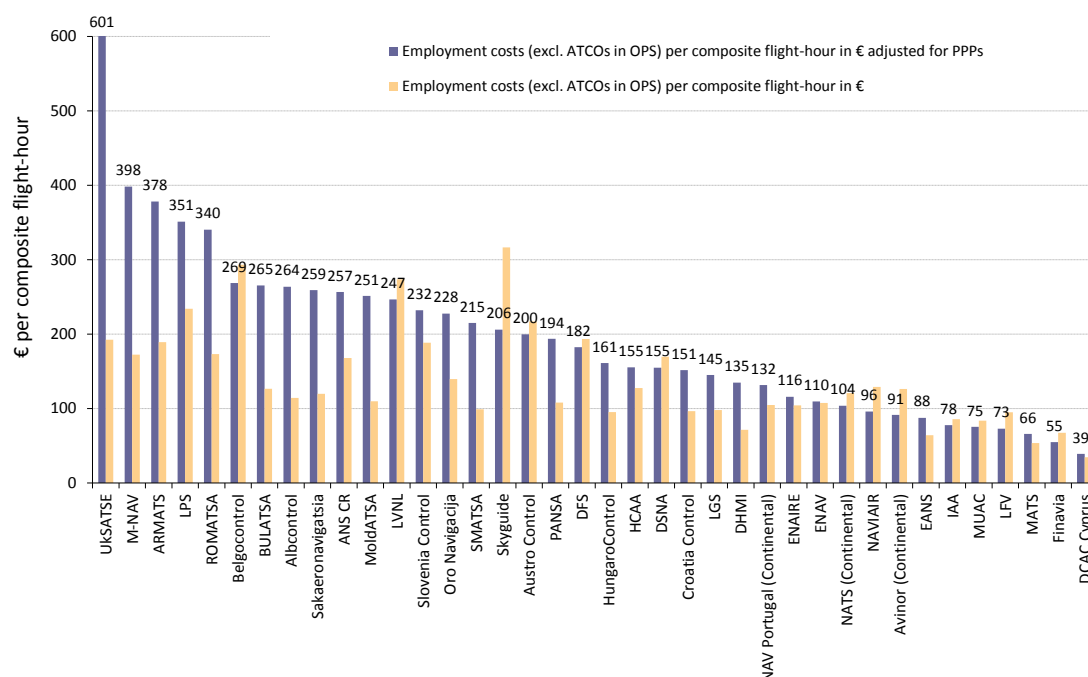


Figure 2.32: Employment costs (excl. ATCOs in OPS) with and without adjustment for PPPs, 2016

After PPP adjustment, the unit employment costs for support staff per composite flight-hour amounts to €152 (compared to €137 without adjustment).

Figure 2.32 indicates that after PPP adjustment, the unit employment costs of many Central and Eastern European ANSPs are generally higher than those operating in Western Europe. As both the cost of living and general wage levels are converging across Europe, there is an upward pressure on employment costs for these ANSPs. In order to sustain the current level of staffing and associated employment costs, it will be of great importance to effectively manage non-ATCO in OPS employment costs.

More details on the level and changes in support costs for individual ANSPs are provided in Part II of this Report.

2.9 Forward-looking cost-effectiveness (2016-2019)

At Pan-European System level, the gate-to-gate unit ATM/CNS provision costs are planned to reduce by -1.1% p.a. between 2016 and 2019. This mainly reflects the fact that over this period traffic is expected to rise faster (+3.6% p.a.) than ATM/CNS provision costs (+2.4% p.a.).

Although, according to the SEID V3.0, ANSPs are expected to report forward-looking information until 2021, seven (Austro Control, DFS, DSNA, EANS, ENAIRE, ENAV and HungaroControl) were not in a position to provide traffic and costs data for the years 2020 and 2021. The analysis provided in this section is therefore limited to the 2016-2019 period. It focuses on the planned gate-to-gate unit ATM/CNS provision costs and the planned capex.

Finally, it is important to note that NATS is excluded from this analysis since forward-looking data (based on regulatory accounting rules) and historical data (based on IFRS) are not directly comparable. As a result, Figure 2.33 below is based on a sample of 37 ANSPs.

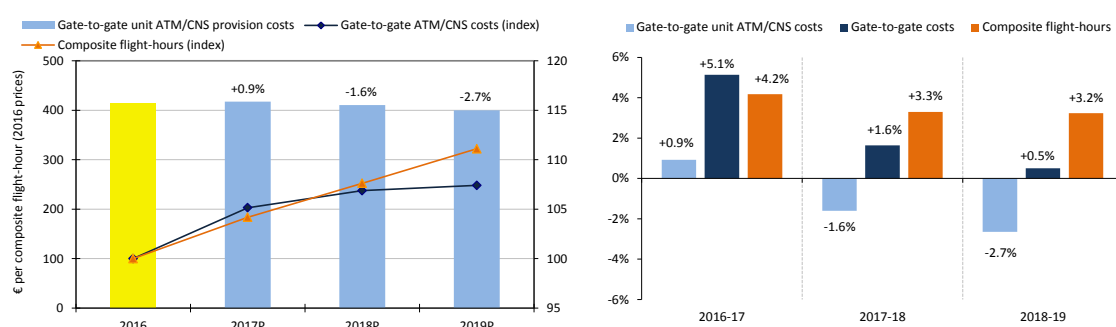


Figure 2.33: Forward-looking cost-effectiveness (2016-2019, real terms)

Figure 2.33 above shows that the gate-to-gate unit ATM/CNS provision costs are planned to slightly decrease (-1.1% p.a.) between 2016 and 2019. This mainly reflects the fact that over this period traffic is expected to rise (+3.6% p.a.) faster than ATM/CNS provision costs (+2.4% p.a.).

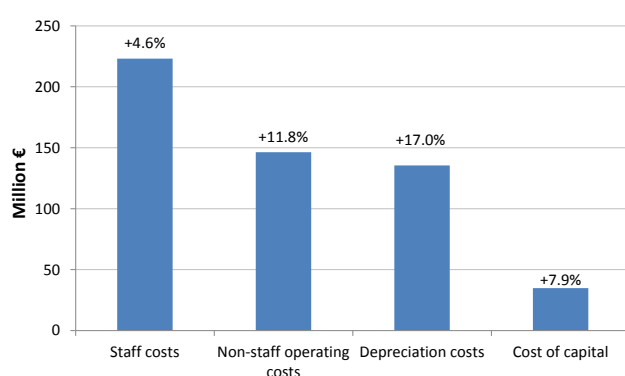


Figure 2.34: Planned changes in ATM/CNS provision costs by cost category (2015-2019)

Figure 2.34 indicates that at Pan-European level all costs categories are planned to rise between 2016 and 2019.

Although staff costs are the main contributor to the planned increase in absolute terms (+€223M or +4.6%), it is noteworthy that non-staff operating costs (+€146M or +11.8%), depreciation costs (+€135M or +17.0%) and the cost of capital (+€35M or +7.9%) are expected to substantially increase by 2019.

The situation observed at Pan-European system level masks contrasted situations among ANSPs. Figure 2.35 below shows ANSPs planned changes in unit ATM/CNS provision costs (light blue bars) over the 2016-2019 period and identifies the costs (dark blue line) and traffic (orange line) effects.

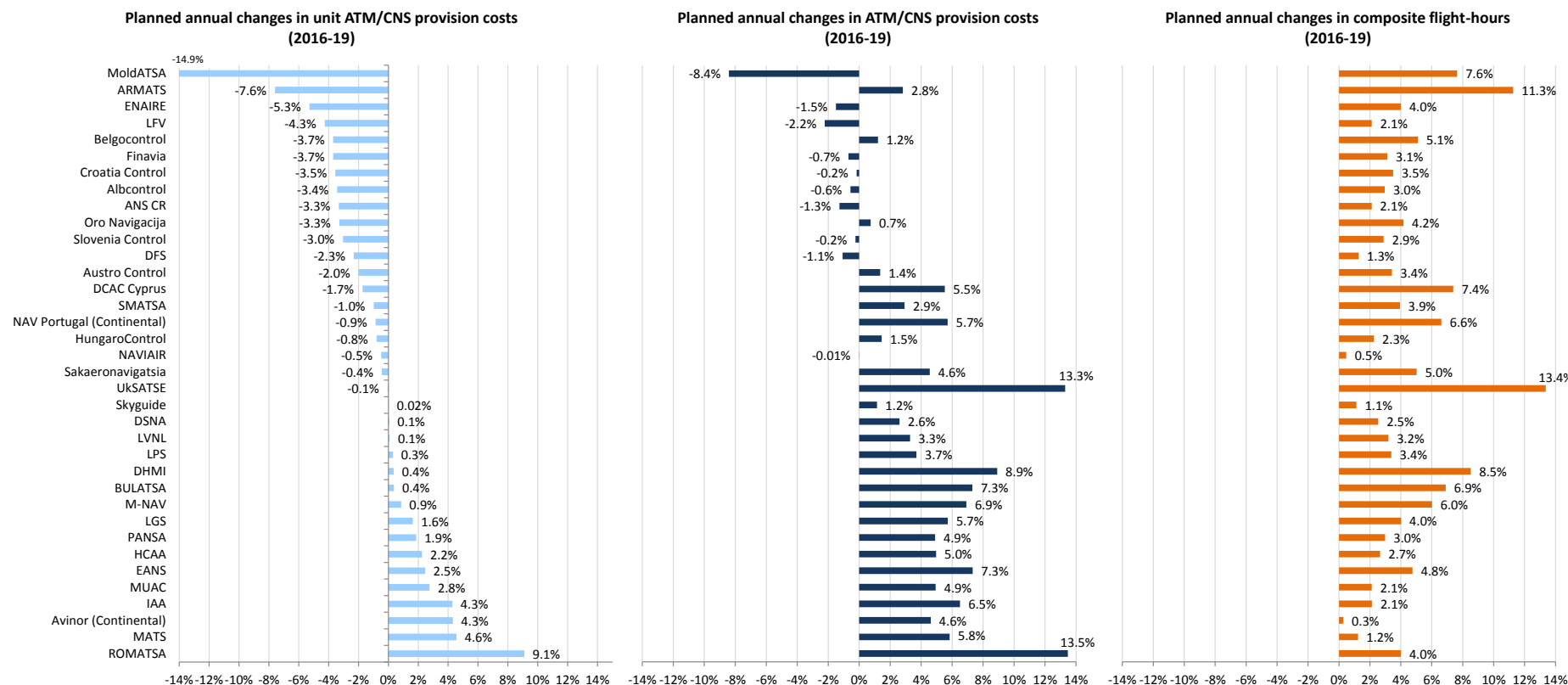


Figure 2.35: Planned annual changes in unit costs over the 2016-2019 period²² (real terms)

²² ENAIRES planned ATM/CNS provision costs comprise costs relating to ATM/CNS infrastructure shared with the military authority, which are charged to civil airspace users. It should be noted that these costs, which are borne by the Spanish Air Force (Ministry of Defence), as well as the corresponding revenues, are not passing through ENAIRES Accounts from 2014 onwards.

Figure 2.35 indicates that 20 ANSPs are planning for decreases in unit ATM/CNS provision costs over the 2016-2019 period. This is particularly the case for ENAIRE (-5.3% p.a.), ARMATS (-7.6% p.a.) and MoldATSA (-14.9% p.a.) who plan for annual decreases in unit costs greater than -5.0%.

- In the case of ENAIRE, this is mainly driven by a forecast traffic increase of +4.0% p.a. combined to a planned decrease in ATM/CNS provision costs (-1.5% p.a.) mainly reflecting lower staff costs.
- For ARMATS, the planned reduction ATM/CNS provision costs is mainly due to the substantial traffic growth which is planned over the 2016-2019 period (+11.3% p.a.) while ATM/CNS provision costs are expected to increase by +2.8% p.a. on average.
- In the case of MoldATSA, ATM/CNS provision costs are expected to substantially reduce by -8.4% p.a. mainly due to planned reductions in non-staff operating costs and capital-related costs, while traffic is expected to rise by +7.6% p.a. on average.

On the other hand, Figure 2.35 shows that between 2016 and 2019 unit ATM/CNS provision costs are expected to rise by more than +5.0% p.a. for ROMATSA (+9.1% p.a.). Indeed, ROMATSA, ATM/CNS provision costs are expected to increase faster (+13.5% p.a.) than traffic volumes (+4.0% p.a.). Detailed analysis indicates that, except for the cost of capital, large increases are planned for all cost categories over the 2016-2019 period.

Finally, it should be noted that although ENAV data is included in the calculation of planned changes at Pan-European system level, no information is shown for this ANSPs in Figure 2.35. In July 2016, ENAV became listed on the Italian Stock Exchange (with 46.6% free float shares and 53.4% State ownership). Being now a listed company, ENAV is subject to specific laws (in particular the Italian Financial Act (Legislative Decree 58/1998)) and is also supervised by the public authority responsible for regulating the Italian financial markets (CONSOB) which oversees and monitors the compliance of all listed companies' behaviour with the financial regulations. As a result of this particular situation, ENAV is not in a position to publicly disclose forward-looking information that could have an effect on the trading levels and prices.

Figure 2.36 below shows the total actual capex and depreciation costs at Pan-European system level between 2011 and 2016 (including the 37 ANSPs that consistently reported ACE data over this period).

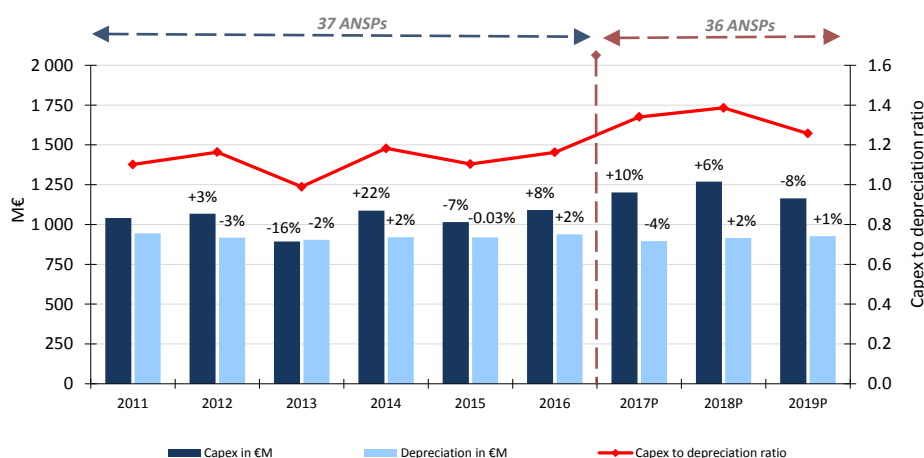


Figure 2.36: Capital expenditures and depreciation costs (2011-2019, real terms)

Figure 2.36 also shows the planned capex and depreciation costs between 2017 and 2019 for the 36 ANSPs that reported this information in their ACE 2016 data submission²³.

The cumulative capex planned for the period 2017-2019 amounts to some €3 635M or an average of €1 212M per year.

The average capex to depreciation ratio planned over 2017-2019 (1.33) is significantly higher than that observed over the 2011-2016 period (1.12). This indicates that, overall, ANSPs asset bases are expected to grow much faster than in the past six years.

Additional information on the nature and magnitude of the major investment projects for each ANSP is provided in Part II of this Report.

²³ Sakaeronavigatsia started to provide ACE data for the year 2015 and this ANSP is therefore excluded from Figure 2.36. In addition, as explained in the introduction of Section 2.9, NATS is excluded from the capex and depreciation costs analysis since forward-looking data (based on regulatory accounting rules) and historical data (based on IFRS) are not directly comparable.

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3 ANSPs ASSETS, LIABILITIES AND CAPITAL EXPENDITURES

3.1 Introduction

Through a factual analysis of assets, liabilities and capex composition at Pan-European level, this chapter aims at providing an informed view on the status of ANSPs' balance sheet and capital expenditures in 2016, and over the 2011-2016 period. The chapter also presents a comprehensive view of the ATM systems landscape in Europe in 2016, with a particular focus on Flight Data Processing Systems (FDPs). Additionally, the chapter provides a high-level overview of the main partnerships and cooperative initiatives put in place by ANSPs for the development of common ATM systems.

The disclosure of consistent and reliable ANS assets and liabilities data is providing particularly difficult for ANSPs which are part of an organisation which owns, manages and operates airports. However, the extensive disclosure of balance sheet information required by the SEID has allowed for a more comprehensive and consistent picture of ANSPs assets and liabilities to be developed over time.

The remainder of this chapter is organised as follows:

- **Section 3.2** provides an overview of the ANSPs assets and liabilities structure at total ANS level. This Section also comprises information on ANSPs liquidity ratios (i.e. the current and quick ratios) and on the Net Book Value (NBV) of fixed assets employed to provide ATM/CNS services;
- **Section 3.3** examines the magnitude of ANSPs capital expenditures in 2016 and their development over the 2011-2016 period;
- **Section 3.4** provides information on the main ATM systems operated by the ANSPs; and,
- **Section 3.5** presents the main industrial partnerships and collaborative initiatives currently in place for the joint development of ATM systems.

3.2 ANSPs assets and liabilities structure

In ANSPs' balance sheets, assets comprise:

- the net book value (NBV) of fixed assets, both in operation and under construction;
- current assets, comprising principally stock, cash and debtors; and,
- long-term financial assets, including investments required to cover provisions for pensions and investments in other companies.

The liabilities comprise:

- capital and reserves – the equity in the organisation, including both shareholders' funds and the accumulated retained profit;
- current liabilities, comprising creditors, short-term loans and provisions; and,
- long-term liabilities, comprising long-term loans, and provisions for pensions and other long-term liabilities.

Figure 3.1 below shows the breakdown of the balance-sheet for the Pan-European ANS system. It displays the total assets and liabilities, provided by the ANSPs in their ACE 2016 data submission, at total ANS level, thus including also these assets and liabilities relating to ANS activities reported under the "Other ANS" column of the SEID (such as Oceanic and OAT).

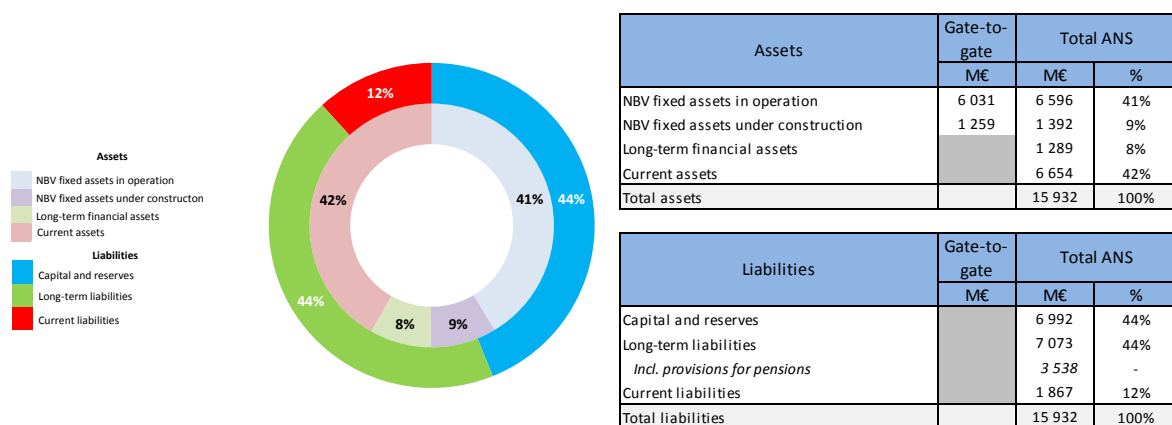


Figure 3.1: ANSPs asset and liability structure²⁴ in 2016

In 2016, half of the total value of ANSPs' assets is linked to fixed assets, whether in operation (41%) or under construction (9%). The remaining half relates to current assets, amounting to 42% of the total, and long-term financial assets (8%).

In 2016, the total NBV of fixed assets used to provide ATM/CNS services amounted to €7 289M, of which 82.7% were assets in operation and 17.3% assets under construction. Figure 3.1 above indicates that fixed assets relate chiefly to systems and equipment (both in operation and under construction), which overall reflect 41.0% of the total NBV of fixed assets.

This asset category comprises the different sets of software and key operational systems directly used by the ANSPs for the provision of ATM services. Given the critical role played by these systems in improving performance across the network, a detailed analysis (with a particular focus on FDP systems) is developed in Section 3.4 of this Chapter.

The remaining categories of fixed assets relate to land and buildings, which account compressively for 34.5% of the total fixed assets, as well as intangible assets and assets related to common projects which represent 15.5% and 9.0%, respectively.

The liability side of the ANSPs' balance sheet, comprises capital and reserves, which represent 44% of the total value of the liabilities while long-term liabilities and current liabilities amount to 44% and 12%, respectively. The main component of the long-term liabilities is relating to provisions for pensions which represent some 22.2% of ANSPs total liabilities.

Figure 3.2 below provides an overview of the evolution of ANSPs total assets²⁵ and main components between 2011 and 2016. During this period, the aggregated value of ANSPs assets rose by +9.5% (or +1.8% p.a.).

Figure 3.2 indicates that this increase mainly reflects a rise in current assets (+6.9% p.a.) while the NBV of fixed assets reduced (-1.8% p.a.) over the period. As a result, the share of current assets in ANSPs total assets rose from 33% in 2011 to 42% in 2016. On the contrary, the share of the NBV of fixed assets decreased from 60% in 2011 to 50% in 2016.

²⁴ In its ACE 2016 data submission, DSN did not report current assets data, and as a result DSN total assets exclusively relate to the NBV of fixed assets in operation and under construction, and to some long-term financial assets.

²⁵ Since Sakaeronavigatsia was included in the benchmarking analysis for the first time in ACE 2015, the trend analyses carried out in this Chapter are made on a sample excluding the Georgian ANSP.

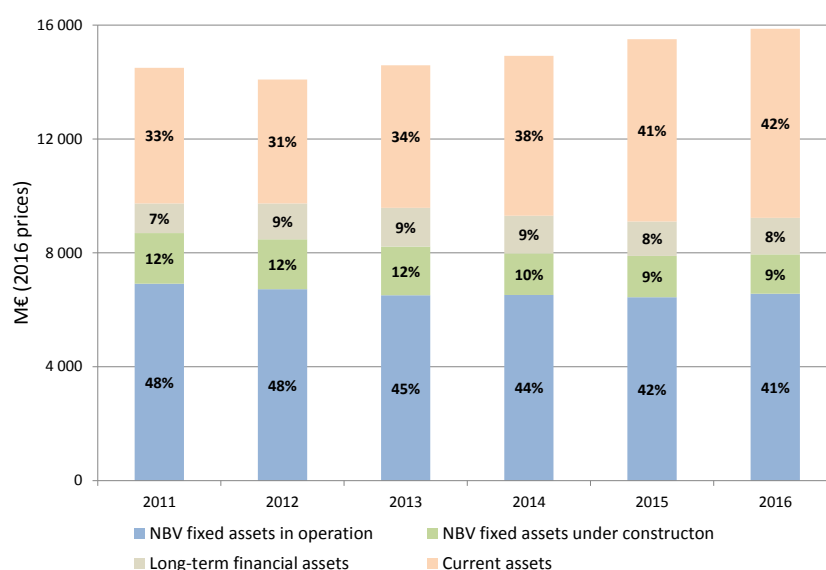


Figure 3.2: Changes in ANSPs assets structure (2011-2016)

Figure 3.3 shows the changes of two liquidity ratios that were computed at Pan-European system level over the 2011-2016 period. The “current” ratio, which is the ratio of current assets to current liabilities, is used to measure the “liquidity” risk and therefore indicates the ANSP’s capability to cover the current debt by employing only “liquid” resources. The “quick ratio” (estimated as the ratio between the sum of short term receivables and cash in hand and the current liabilities) is a more stringent measure of liquidity.

Figure 3.3 indicates that the “current” ratio of the Pan-European system amounted to some 3.56 in 2016. This is a relatively high value which indicates that by using only liquid assets, ANSPs would be able to cover more than three and a half times their current liabilities.

Even when using the “quick ratio”, the value remains largely above 1 (i.e. 2.34 in 2016). This indicates that, on average, ANSPs would be able to pay 234% of their current debt by only using their most “liquid” assets.

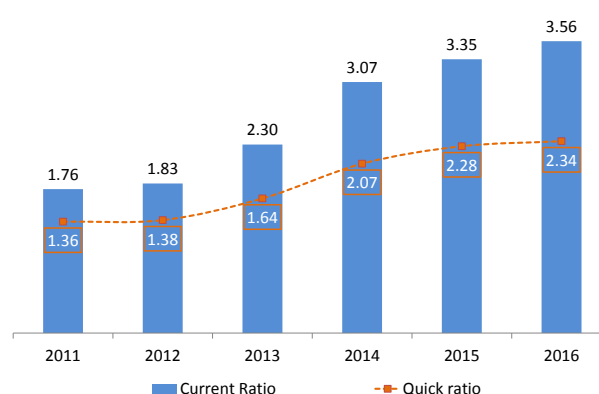


Figure 3.3: Current and quick ratios at Pan-European system level (2011-2016)

Between 2011 and 2016, both liquidity ratios substantially increased at Pan-European system level (a factor 2.0 for the current ratio and a factor 1.7 for the quick ratio). These changes partly result from the increase in current assets presented in Figure 3.2 above (+6.9% p.a.), and in particular to the amount of cash in hand or at bank which rose by +14.9% p.a. between 2011 and 2016 based on the information provided by ANSPs in their ACE data submissions. The other driver was a reduction of current liabilities (-7.2% p.a.) over the period.

3.3 ANSPs gate-to-gate capital expenditures

In order to better understand the evolution of ANSPs fixed assets between 2011 and 2016, it is relevant to analyse the investment strategies and the amount of capital expenditures spent during this period.

The Pan-European system gate-to-gate capex amounted to some €1 108M in 2016.

Figure 3.4 indicates that most of this capex reflects investment relating to systems and equipment (48% of the total), and, to a lesser extent, investments in common projects (22%).

Investments relating to land and buildings, and intangible assets represented 14% and 16% of the total gate-to-gate capex in 2016.

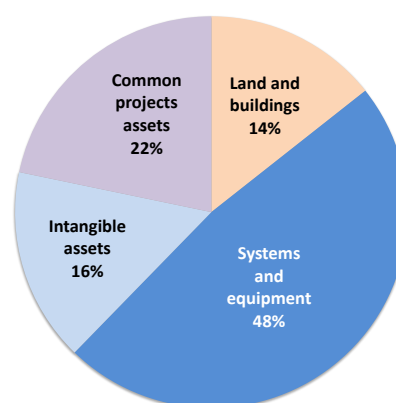


Figure 3.4: Total ANSPs' gate-to-gate capex (2016)

Figure 3.5 below shows the changes in the capex spent by Pan-European ANSPs over the 2011-2016 period. The cumulative capex spent over the six years amounted to €6 196M (on average, about €1 033M per year). This represents 11.1% of the gate-to-gate ANS revenues generated over the period. The “capex to revenues” ratio can be considered as an indication of the magnitude of the investment taking into account the size of ANSPs (expressed in terms of revenues).

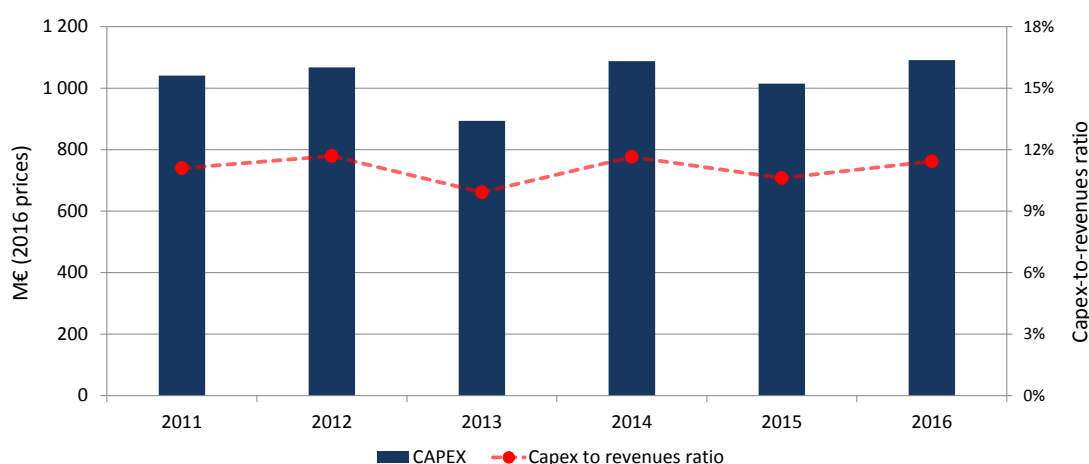


Figure 3.5: Changes in ANSPs gate-to-gate capex (2011-2016)

Figure 3.5 also shows that at the exception of 2013 (€894M) ANSPs gate-to-gate capex were between €1000M-€1100M every year between 2011 and 2016. This average figure is the combination of different investment cycles for individual ANSPs.

Figure 3.6 displays the cumulative capex to revenues ratios for each ANSP over the 2011-2016 period.

For 19 ANSPs, the cumulative capex to revenues ratio is higher than for the Pan-European system as a whole (11.1%).

For four ANSPs, this indicator is above 20% indicating that relatively high amounts of capex were spent by these ANSPs during this period. These capex could be an extension of an investment cycle started before 2011, or reflecting the start of a new investment cycle between 2011 and 2016.

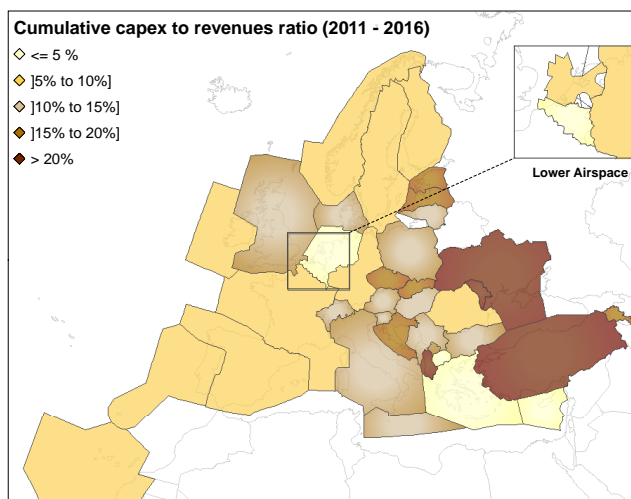


Figure 3.6: ANSPs cumulative capex to revenues ratio (2011-2016)²⁶

On the other hand, for some ANSPs, the cumulative capex to revenue ratio is much lower than for the Pan-European system as a whole. This is particularly the case for M-NAV (3.9%), DCAC Cyprus (3.7%), Belgocontrol (2.5%) and HCAA (1.1%) for which the cumulative capex to revenues ratio over the 2011-2016 period is significantly lower than 5%. For most of these ANSPs, this lower ratio mainly reflects the cost-containment measures implemented in 2010-2011 during the economic recession and in particular the postponement or cancellation of non-crucial investment projects.

Additional information on the nature and magnitude of the major investment projects for each ANSP is provided in Part II of this Report.

²⁶ It should be noted that in the case of MUAC, which is entirely financed through the contribution of the Four-States, the value presented in Figure 3.6 is obtained as the ratio between capex and the gate-to-gate ATM/CNS provision costs. In addition, Sakaeronavigatsia started to provide ACE data for the year 2015 and this ANSP is therefore excluded from Figure 3.6. It should be noted that Sakaeronavigatsia capex-to-revenues ratio amounted to 41.8% over the 2015-2016 period indicating a significant investment cycle for this ANSP.

As part of the Specification for Economic Information Disclosure reporting requirements, high level information on the main ATM systems is collected and analysed. This information includes the name of the system and/or the supplier as well as the dates of commissioning, upgrades and planned replacement for Flight Data Processing Systems (FDPs), Radar Data Processing Systems (RDPS), Human Machine Interface (HMI) and Voice Communication Systems (VCS). The analysis presented in this section will focus on the FDP systems that are operated by the 38 ANSPs part of the ACE 2016 benchmarking analysis.

FDP system suppliers

- Aerotekhnika
- Azimut OJSC
- Bespoke
- CS SOFT
- Indra
- Lockheed Martin
- Raytheon
- SI ATM
- Selex
- Thales

Lower Airspace

Lower Airspace

Market Share Pie Chart

Supplier	Market Share (%)
Thales	18%
SELEX	21%
INDRA	23%
Bespoke	19%
Raytheon/Indra - Raytheon	8%
Lockheed Martin	7%
Other	3%

The right-hand side of Figure 3.7 shows how FDP systems from different suppliers serve the Pan-European system traffic measured in terms of flight-hours. In 2016, the largest suppliers in terms of flight-hours controlled were INDRA (23%), SELEX (21%) and Thales (18%):

- Beside these three main providers, there are a number of FDP System suppliers characterised by a narrower scope. These include suppliers as Lockheed Martin and Raytheon (US-based), CS-SOFT (Czech-based), Azimut OJSC (Russian-based), SI ATM (Swedish-based) and AeroTehnika

(Ukrainian-based). Finally, it should be noted that a number of ACCs – i.e. the ones operated by DSNA (Reims, Paris, Marseille, Brest and Bordeaux), Skyguide (Zurich and Geneva) and NAV Portugal (Lisbon) – still employ bespoke systems developed internally.

The top chart of Figure 3.8 below presents the trend in the market share expressed in terms of IFR flight hours controlled for the main FDP systems providers between 2005 and 2016. The bottom chart of Figure 3.8 indicates the number of ACCs which operates the main suppliers' FDP systems and the number of flight-hours served by these systems²⁷.

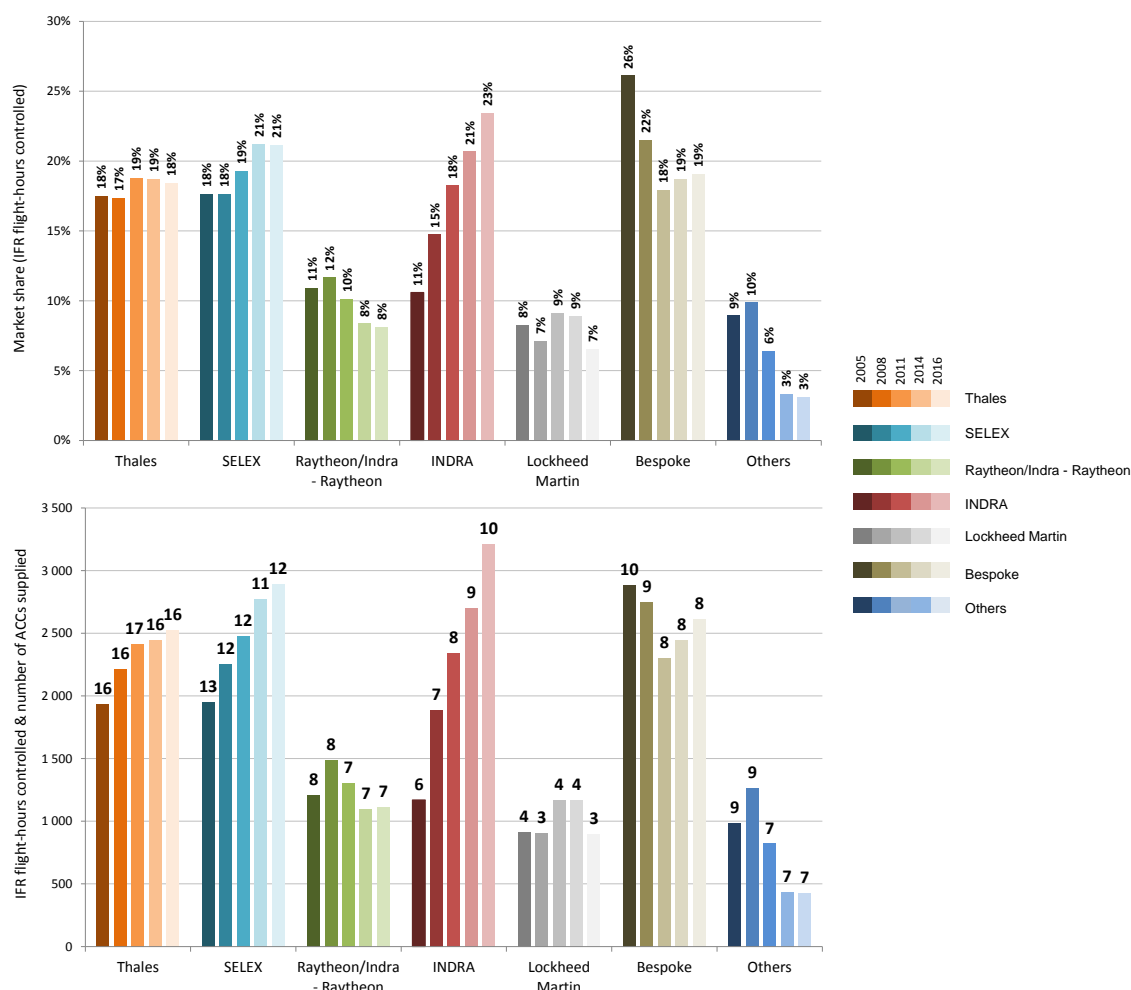


Figure 3.8: Share of FDP systems suppliers in terms of flight-hours controlled (2005-2016)

The top chart in Figure 3.8 shows that INDRA is the supplier which experienced the highest growth in market share (i.e. from 11% in 2005 to 23% in 2016). This increase mainly reflects the fact that a number of ACCs initially operating a different system switched to INDRA during this period (i.e. from 6 ACCs in 2005 to 10 ACCs in 2016, as indicated in the bottom chart). This was the case for Warsaw ACC, which in 2011 replaced its old system (provided by Northrop Grumman) with a new one provided by INDRA (Pegasus), MUAC (2008), Karlsruhe UACs (2011) and also Prestwick ACC, which in 2016 implemented the new INDRA iTEC system.

²⁷ When interpreting the changes in terms of number of ACCs in Figure 3.8, it is important to note that three ANSPs joined the ACE benchmarking analysis between 2005 and 2016: SMATSA (2006), ARMATS (2009) and Sakaeronavigatsia (2015). For the sake of completeness, these ANSPs are included in Figure 3.8 for the years when they provided ACE data.

On the other hand, for SELEX, the increase in the market share (from 18% in 2005 to 21% in 2016), is mainly the result of the substantial traffic growth experienced by some of the ACCs which operate a FDP system provided by this supplier. This is particularly the case for Ankara ACC (DHMI) whose traffic rose by +10.6% p.a. between 2005 and 2016.

Figure 3.8 also indicates that Thales's market share remained fairly constant over time (around 18%). This mainly reflects the fact that the number of ACCs which employed a FDP system supplied by Thales remained fairly stable over time (16 ACCs).

Finally, Figure 3.8 shows that the market share of the other suppliers reduced between 2005 and 2016 mainly as a result of a number of ACCs switching to systems provided by one of the main suppliers. Similarly, ANSPs tended to abandon bespoke FDP systems developed in-house and to go for a COTS (Commercial Off-The-Shelf) solution.

3.5 Main industrial partnerships and collaborative initiatives

As indicated above, some ANSPs are part of the same industrial partnership for the common development and/or joint procurement of ATM systems. Currently 15 of the ANSPs part of the ACE benchmarking analysis are involved in one of the three main partnerships: the COOPANS and iTEC alliances, and the COFLIGHT Partnership.

- **COOPANS** (COOPERation in the Procurement of Air Navigation Systems) is an alliance established in 2006 and currently comprising five ANSPs: three founding members, LFV (Sweden), NAVIAIR (Denmark) and IAA (Ireland), plus Austro Control (Austria), which joined the alliance in 2010, and Croatia Control (Croatia) as of 2011. Currently, Thales is the single chosen provider of FDP systems for the ANSPs part of the COOPANS alliance which all employ the TopSky ATM system. Through a number of joint activities such as common specifications and joint procurement of upgrades, COOPANS achieved full system harmonisation and interoperability as of 2014.
- **iTEC** (interoperability Through European Collaboration), is a collaboration based on a long-term agreement that began in 2005 between three founding members – DFS (Germany), ENAIRE (Spain) and NATS (UK) – to jointly develop the next generation of FDP System (iTEC-eFDP) through common specifications. However, the iTEC initiative has further expanded overtime towards developing a complete ATM system package, including also the development of common HMIs, controller safety and productivity tools. In terms of FDP Systems, INDRA is the single chosen provider for the member of the iTEC alliance. To date, following the extension of the alliance to four new members – Oro Navigacija (Lithuania), Avinor (Norway), PANSA (Poland) and LVNL (Netherlands) – iTEC became the largest collaborative initiative in Europe, involving overall seven ANSPs. However, it should be noted that, although iTEC partners work closely together in the development of their systems, their deployment plans are independent from each other and adapted to the ANSP's specific requirements; thus, at present, not all the partners are at the same stage of development and only two ACCs (Karlsruhe UAC and Scottish ACC) have made the iTEC-eFDP operational so far.
- **COFLIGHT** is a collaboration between DSNA (France), ENAV (Italy) and Skyguide (Switzerland) for the common definition, development and procurement of a new generation of SESAR-compliant FDP system. The industrial consortium in charge of developing the FDP system used by these ANSPs is led by Thales and SELEX. The objective of the COFLIGHT programme is to progressively replace all existing FDP systems operated by the three ANSPs mentioned above with a common new generation of systems ensuring full interoperability across the different ACCs. As for the iTEC alliance, the COFLIGHT partners have independent deployment plans. DSNA (from 2019 onwards) and ENAV (in 2020-2021) are expected to deploy the new system in all their ACCs in the coming years.

Further initiatives towards achieving a higher level of shared infrastructure and/or interoperable systems are encouraged. The bulk of investment being related to software, there should be a high potential for reducing procurement, development and maintenance costs if ATM systems are jointly developed as part of common initiatives. Similarly, a higher level of interoperability between FDP systems (regardless of whether they have been supplied by the same company or not) should bring operational benefits to ANSPs.

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PART II: COST-EFFECTIVENESS PERFORMANCE FOCUS AT ANSP LEVEL (2011-2021)

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4 FOCUS ON ANSPs INDIVIDUAL COST-EFFECTIVENESS PERFORMANCE

4.1 Objective of this chapter

This chapter comprises two pagers for each ANSP participating to the ACE 2016 analysis. These two pagers include an analysis of the historical development of the financial cost-effectiveness indicator and its main components over the 2011-2016 period. Individual ANSP cost-effectiveness performance is also examined in the context of a group of ANSPs which operate in relatively similar operational and economic environments (comparator groups). Finally, these two pagers comprise historical information and projections about capital expenditures provided by each ANSP.

4.2 Historical development of cost-effectiveness performance, 2011-2016

The first page presents, for each ANSP, an assessment of its cost-effectiveness performance, and how it has developed over the five-year period 2011-2016. It examines the overall economic cost-effectiveness indicator and its two components (ATM/CNS costs per composite flight-hour, ATFM delay costs per composite flight-hour), and their evolution over the period (top left). It puts these in the context of the traffic growth observed in the ANSP's airspace (top right). In this page, financial data are all expressed in real terms (2016 prices). For consistency purposes, the cost of a minute of ATFM delays used for the 2011-2016 period is that of the year 2016 (€100) and is based on the findings of the study "European airline delay cost reference values" realised by the University of Westminster in March 2011, and updated in December 2015. Further details are available in Annex 2 of this report.

Developments in the components of financial cost-effectiveness (ATCO-hour productivity, ATCO employment costs per ATCO-hour, and support costs per composite flight-hour) are also examined (middle left), to help understand the underlying causes of changes in overall cost-effectiveness.

The charts on the middle right provide additional information in order to better understand the drivers behind the changes in the three components of financial cost-effectiveness. First, the changes in ATCO-hour productivity are examined in the light of changes in composite flight-hours, number of FTE ATCOs in OPS and corresponding hours on duty. A second chart focuses on the changes in ATCO-hours on duty, and in particular on overtime hours. The third chart presents the changes in support costs are broken down into employment costs of staff other than ATCOs in OPS; non-staff operating costs; capital-related costs (depreciation and the cost of capital); and exceptional items, where present.

The bottom set of graphs examine how the changes in the components over the whole period contribute to the change in the overall financial cost-effectiveness indicator. The left-hand graphs relate to ATCOs in OPS; the right-hand graphs to other elements of cost ("support costs"). The left-hand graphs show how the change in ATCO productivity combines with the change in unit ATCO employment costs to make a change in ATCO employment costs per unit output. The right-hand graphs show how the change in support costs combines with traffic growth to make a change in support costs per composite flight-hour. The relative contribution of these two effects to the change in the financial cost-effectiveness indicator depends on the relative weight of ATCO employment costs, on the one hand, and support costs, on the other, in the overall ATM/CNS provision costs.

The presentation of financial time-series data

Presentation and comparison of historical series of financial data from different countries poses problems, especially when different currencies are involved, and inflation rates differ. There is a danger that time-series comparisons can be distorted by transient variations in exchange rates which happened to be particularly the case in 2009-2010 in the wake of the financial crisis. In this chapter, the focus is on the historical development of financial performance indicators **in a given ANSP**.

For this reason, the following approach has been adopted for allowing for inflation and exchange rate variation. The financial elements of performance are assessed, for each year, in **national** currency. They are then converted to national currency in 2016 prices using national inflation rates. Finally, for comparison purposes in 2016, all national currencies are converted to euros using the 2016 exchange rate.

This approach has the virtue that an ANSP's performance time series is not distorted by transient changes in exchange rates over the period. It does mean, however, that the performance figures for any ANSP in a given year prior to 2016 are not the same as the figures in that year's ACE report, and cannot legitimately be compared with another ANSP's figures for the same year. Cross-sectional comparison using the figures in this report is only appropriate for 2016 data.

The historical inflation figures used in this analysis were obtained from EUROSTAT or from the International Monetary Fund. For the projections, the ANSPs' own assumptions concerning inflation rates were used. Details of the monetary parameters used for 2016 are given in Annex 7 to this report.

4.3 ANSP's cost-effectiveness within the comparator group, 2011-2016

The top charts of the second page present the financial cost-effectiveness indicator and its main components for individual ANSPs in comparison with their respective comparator group. The approach is to consider each ANSP in the context of a group of other ANSPs (comparators) which operate in relatively similar operational and economic environments.

The chart on the top-left shows the level and changes in unit ATM/CNS provision costs over the 2011-2016 period for each ANSP part of the comparator group. The chart on the top-right shows for each ANSP the deviations in unit ATM/CNS provision costs, ATCO-hour productivity, employment costs per ATCO-hour and unit support costs from the average of the comparator group at the start (2011) and at the end (2016) of the period considered.

The ANSP comparator groups used for the benchmarking analysis are presented in the table below. These comparator groups were determined for the purposes of the RP2 cost-efficiency target-setting process using a two-step approach combining the use of statistical tools (cluster analysis) with expert judgement. For a full description of the process, methodology and results see Annex I.C of the PRB report on RP2 EU-Wide Targets Ranges released in May 2013.

Nine groups of comparators have been identified, some comprising a relatively large number of ANSPs and others only comprising two organisations. Due to the unique nature of its airspace (upper airspace only, across four States), it was determined that Maastricht (MUAC) should be considered separately and therefore this ANSP was not included in the comparator group benchmarking analysis. Finally, two groups have been designed for the ANSPs not operating in SES States. It should be noted that the names of these groups have been chosen for mnemonic purposes only.

Comparator Groups	ANSPs
Five Largest	ENAIRE
	DFS
	DSNA
	ENAV
	NATS (Continental)
Central Europe	ANS CR
	HungaroControl
	LPS
	Slovenia Control
	Croatia Control
	PANSA
South Eastern Europe	HCAA
	BULATSA
	ROMATSA
South Med	DCAC Cyprus
	MATS
Western Europe	Austro Control
	NAVIAIR
	Skyguide
Atlantic	NAV Portugal (Continental)
	IAA
Baltic States	EANS
	LGS
	Oro Navigacija
Nordic States	Avinor (Continental)
	LFV
	Finavia
BelNed	Belgocontrol
	LVNL
Non-SES 1	DHMI
	UKSATSE
Non-SES 2	Albcontrol
	ARMATS
	M-NAV
	MoldATSA
	Sakaeronavigatsia
	SMATSA

Table 4.1: ANSPs comparator groups

4.4 Historical and forward-looking information on capital investment projects (2011-2021)

The charts which are displayed in the middle and the bottom of the second page provide historical information and projections about capital expenditures provided by each ANSP.

The chart on the middle of the page shows the historical and planned evolution of capital expenditure and depreciation, highlighting the ANSP's investment cycles and their magnitude, across time. The ratio of these quantities (usually greater than one) is an indication of the rate at which the overall asset base is being expanded.

Finally, two tables present information on the nature of the main ANSP's capex projects between 2011 and 2021. The first table provides a high-level overview of the magnitude of historic and planned capital expenditures by area (i.e. ATM, Communication, Surveillance, etc.) and of the

upgrade/replacement cycles of the main ATM systems for each ACC. The capex allocation by area is not always straightforward, especially when ANSPs report under a large project several smaller investments relating to different areas. The classification disclosed in this report therefore reflects the PRU understanding based on information provided by ANSPs during the validation process. In case of a project covering several areas, the rationale was to classify the whole project into the domain where the investment project was mostly contributing. The last table provides detailed information on the top 5 capex projects in monetary terms including the domain, the financial amount and the time period of the project.

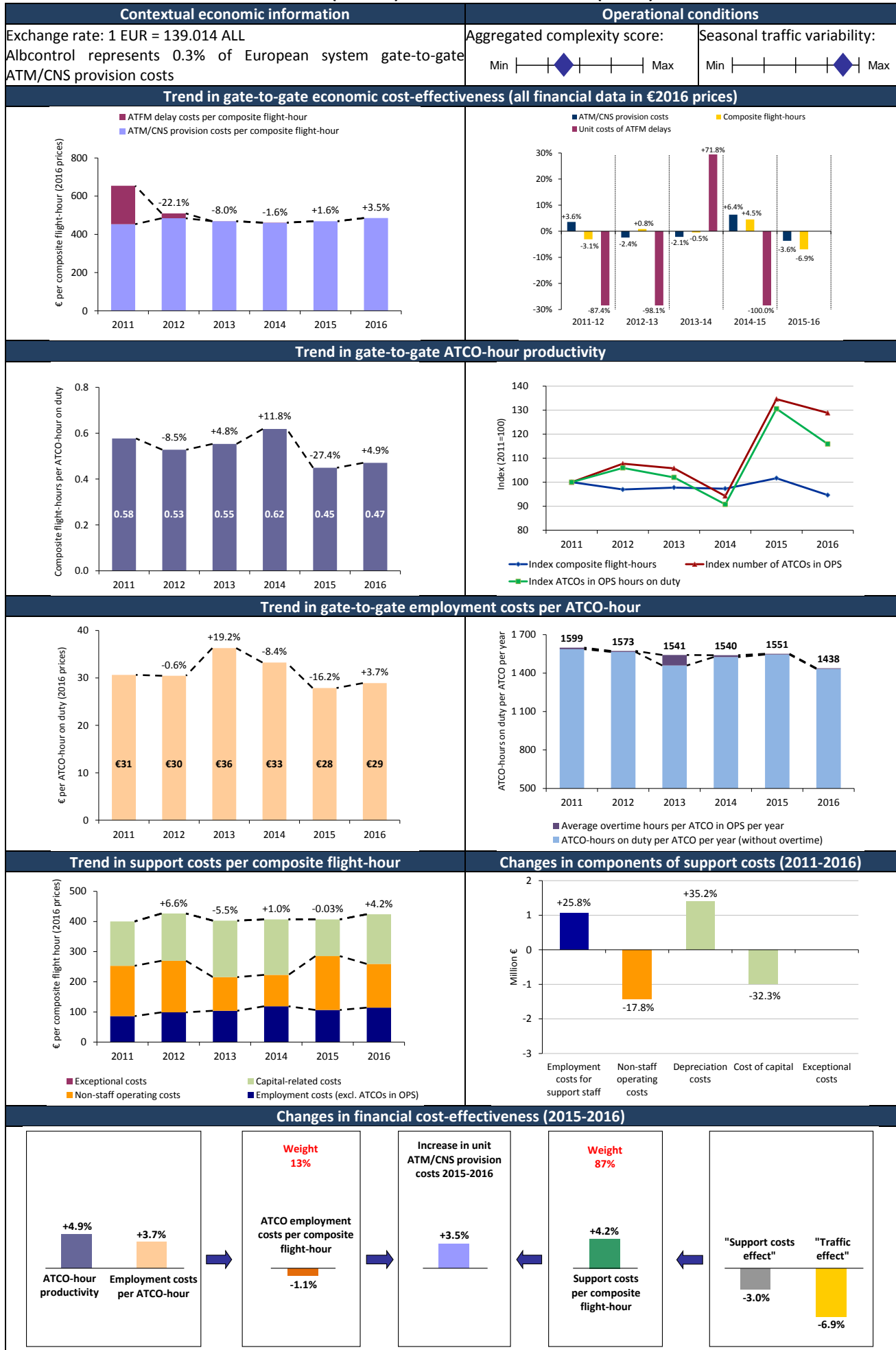
4.5 Cost-effectiveness performance focus at ANSP level

To facilitate the reading of this section, the table below displays the page number of the individual benchmarking analysis for each ANSP.

ANSP name	Country	Page
Albcontrol	Albania	62
ANS CR	Czech Republic	64
ARMATS	Armenia	66
Austro Control	Austria	68
Avinor (Continental)	Norway	70
Belgocontrol	Belgium	72
BULATSA	Bulgaria	74
Croatia Control	Croatia	76
DCAC Cyprus	Cyprus	78
DFS	Germany	80
DHMI	Turkey	82
DSNA	France	84
EANS	Estonia	86
ENAIRE	Spain	88
ENAV	Italy	90
Finavia	Finland	92
HCAA	Greece	94
HungaroControl	Hungary	96
IAA	Ireland	98
LFV	Sweden	100
LGS	Latvia	102
LPS	Slovak Republic	104
LVNL	Netherlands	106
MATS	Malta	108
M-NAV	F.Y.R. Macedonia	110
MoldATSA	Moldova	112
MUAC		114
NATS (Continental)	United Kingdom	116
NAV Portugal (Continental)	Portugal	118
NAVIAIR	Denmark	120
Oro Navigacija	Lithuania	122
PANSA	Poland	124
ROMATSA	Romania	126
Sakaeronavigatsia	Georgia	128
Skyguide	Switzerland	130
Slovenia Control	Slovenia	132
SMATSA	Serbia and Montenegro	134
UKSATSE	Ukraine	136

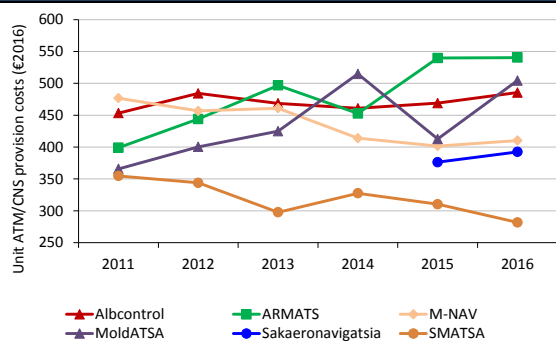
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Albcontrol (Albania) – Cost-effectiveness KPIs (€2016)

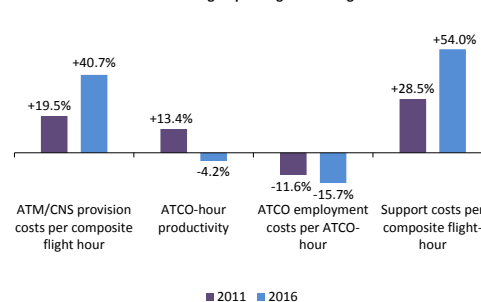


Albcontrol (Albania) – (€2016)

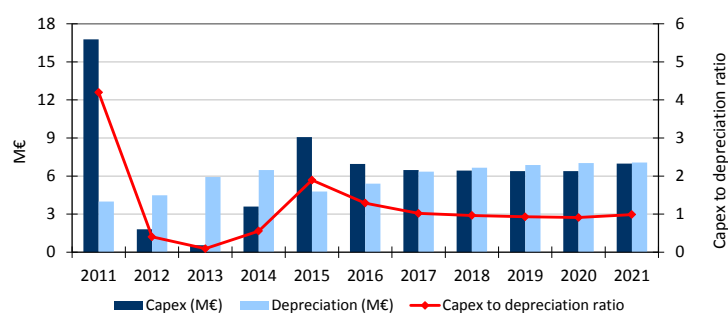
Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Deviation from groups' weighted average



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS C: 2004*	RDPS C: 2006*	HMI C: 2004*	VCS C: 2011*
€17.4M (2008-2012)	€2.0M (2008-2012)	€1.6M (2010-2011)		€13.6M (2008-2011)		2011				
						2012				
						2013				
						2014				
€13.2M		€4.5M		€0.6M		2015				
	€4.2M					2016				
						2017				
			€12.5M		€1.1M**	2018				
						2019				
						2020				
						2021				

** This amount includes €0.5M related to MET

* C = Commissioning

Upgrade

Replacement

Focus on the top five capex projects

Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Purchase of a new ATM system	ATM	14.6	2008	2012
2	New joint ACC/APP/TWR building located near Mother Teresa Airport	Buildings	13.6	2008	2011
3	Implementation of WAM (extension of MLAT)	SUR	6.0	2018	2020
4	Implementation of MLAT	SUR	5.0	2017	2019
5	Upgrade of new Skyline technology, free route airspace, stripless, surveillance, ATCO monitoring hours on duty and implementation of Skyline capability to process MLAT data	ATM	4.8	2016	2017

Contextual economic information

Exchange rate: 1 EUR = 27.012 CZK
ANS CR represents 1.5% of European system gate-to-gate ATM/CNS provision costs

Operational conditions

Aggregated complexity score:
Min |-----| Max

Seasonal traffic variability:
Min |-----| Max

Trend in gate-to-gate economic cost-effectiveness (all financial data in €2016 prices)

Year	ATFM delay costs per composite flight-hour (%)	ATM/CNS provision costs per composite flight-hour (%)
2011	-	-
2012	-3.2%	-
2013	+5.8%	-
2014	-0.9%	-
2015	-6.3%	-
2016	+3.4%	-

Period	ATM/CNS provision costs (%)	Unit costs of ATFM delays (%)	Composite flight-hours (%)
2011-12	-6.6%	-77.9%	-4.9%
2012-13	1.8%	-0.7%	+766.0%
2013-14	1.7%	-51.7%	+0.7%
2014-15	-0.8%	-66.1%	+4.7%
2015-16	9.5%	+5.9%	+12.9%

Trend in gate-to-gate ATCO-hour productivity

Year	Composite flight-hours per ATCO-hour on duty
2011	0.93
2012	0.89
2013	0.88
2014	0.87
2015	0.96
2016	1.02

Year	Index composite flight-hours	Index number of ATCOs in OPS	Index ATCOs in OPS hours on duty
2011	100	100	100
2012	95	102	98
2013	94	101	100
2014	95	98	102
2015	100	98	97
2016	105	98	97

Trend in gate-to-gate employment costs per ATCO-hour

Year	€ per ATCO-hour on duty (€2016 prices)
2011	€88
2012	€77
2013	€79
2014	€85
2015	€89
2016	€101

Year	Average overtime hours per ATCO in OPS per year	ATCO-hours on duty per ATCO per year (without overtime)
2011	1534	1450
2012	1495	1420
2013	1532	1430
2014	1569	1450
2015	1512	1430
2016	1513	1420

Trend in support costs per composite flight-hour

Year	Exceptional costs (%)	Capital-related costs (%)	Non-staff operating costs (%)	Employment costs (excl. ATCOs in OPS) (%)
2011	-	-	-	-
2012	+0.3%	-	-	-
2013	+1.9%	-	-	-
2014	-0.8%	-	-	-
2015	-5.6%	-	-	-
2016	+2.5%	-	-	-

Component	Change (%)
Employment costs for support staff	+12.0%
Non-staff operating costs	-5.5%
Depreciation costs	-12.5%
Cost of capital	+18.8%
Exceptional costs	-

Changes in financial cost-effectiveness (2015-2016)

Weight 23%

+5.8%

ATCO-hour productivity

Weight 77%

+2.5%

Support costs per composite flight-hour

Weight 23%

+6.4%

ATCO employment costs per composite flight-hour

Weight 77%

+3.4%

Increase in unit ATM/CNS provision costs 2015-2016

+8.6%

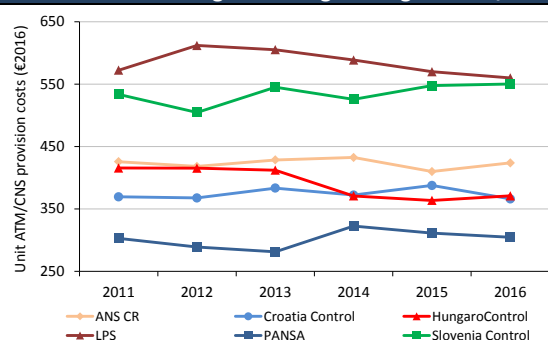
"Support costs effect"

+5.9%

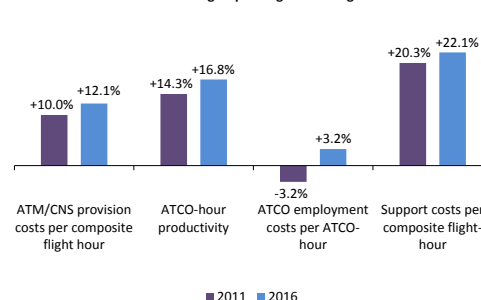
"Traffic effect"

ANS CR (Czech Republic) – (€2016)

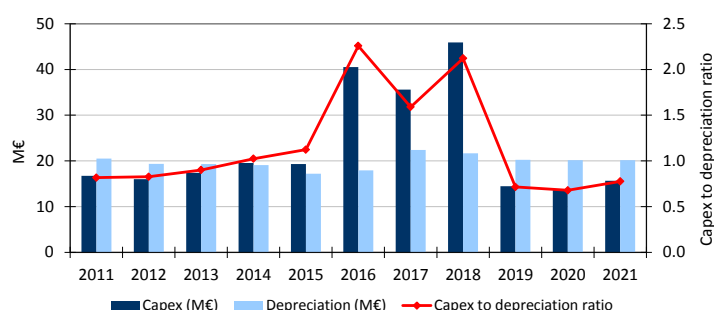
Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Deviation from groups' weighted average



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 1994*	C: 2000*	C: 2007*	C: 2007*
€117.9M (2010-2021)	€20.4M (2011-2022)		€4.9M (2010-2013)	€24.0M (2008-2019)		2011				
		€2.1M				2012				
					€2.1M	2013				
			2014							
		2015								
		2016								
		2017								
		2018								
		2019								
		2020								
		2021								

* C = Commissioning

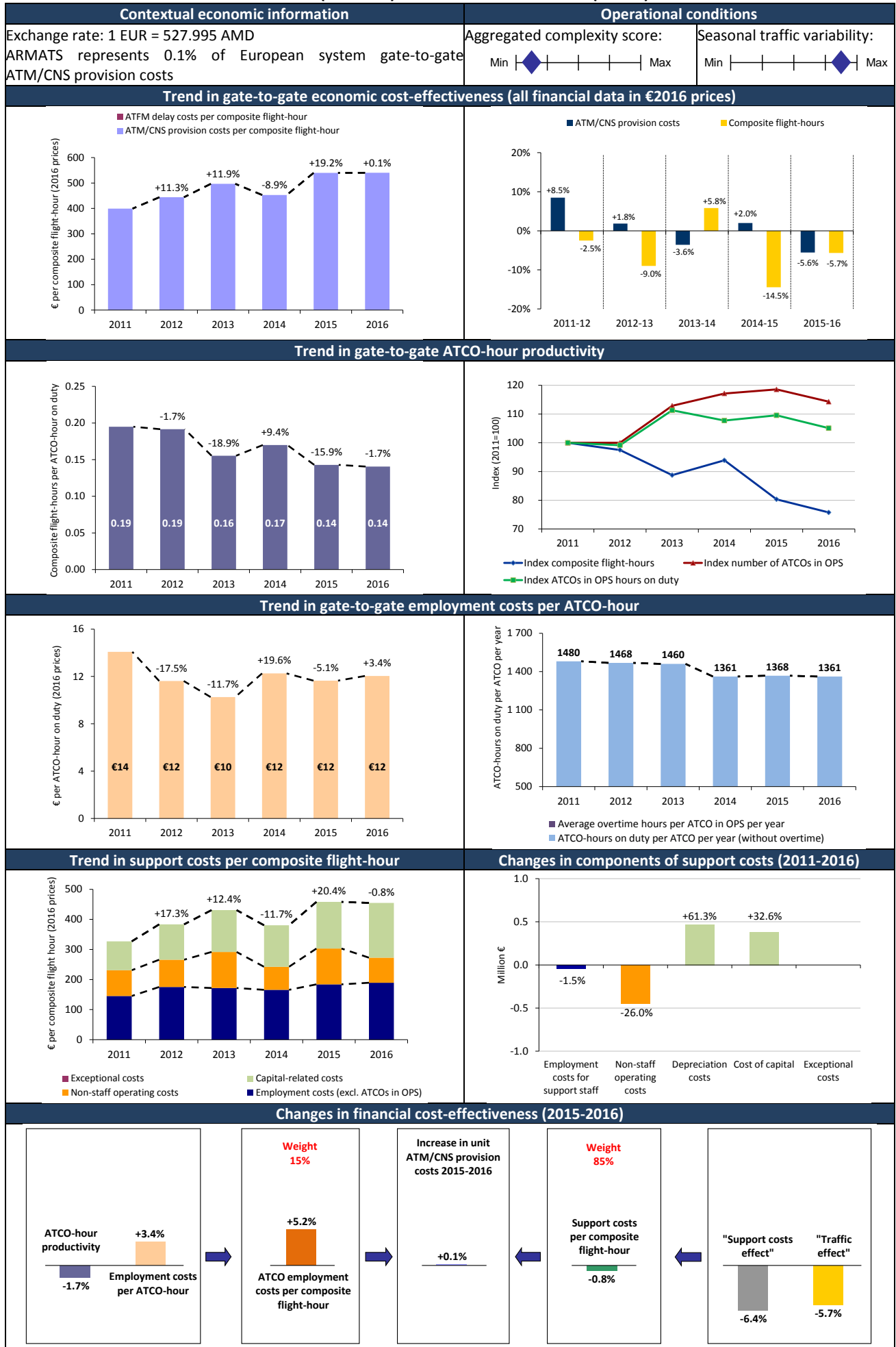
Upgrade

Replacement

Focus on the top five capex projects

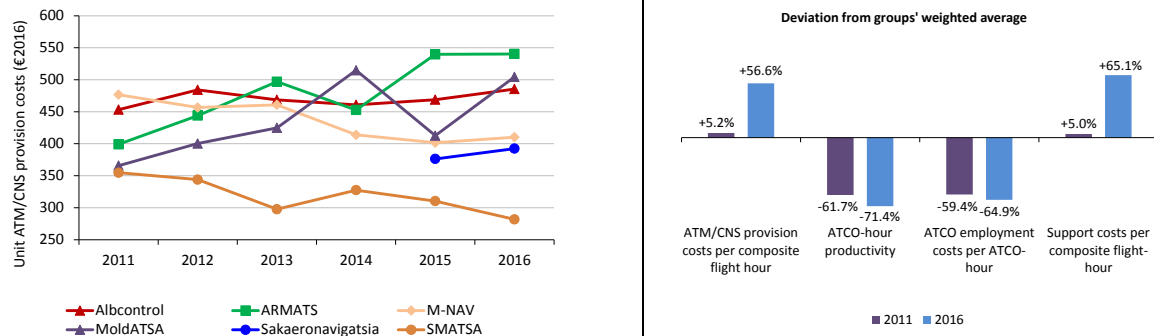
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Replacement of RDP and FDP systems in Praha ACC (Neopteryx)	ATM	39.0	2010	2021
2	Upgrade of E2000, ESUP and IDP	ATM	22.9	2017	2020
3	Upgrade of RDP and FDP secondary systems (approach to Neopteryx)	ATM	17.5	2015	2019
4	"TB 2007" Project involving the complete renovation of the "Technical Block Building" at Prague airport	Buildings	12.2	2008	2011
5	IDP upgrade 2016	ATM	8.8	2016	2016

ARMATS (Armenia) – Cost-effectiveness KPIs (€2016)

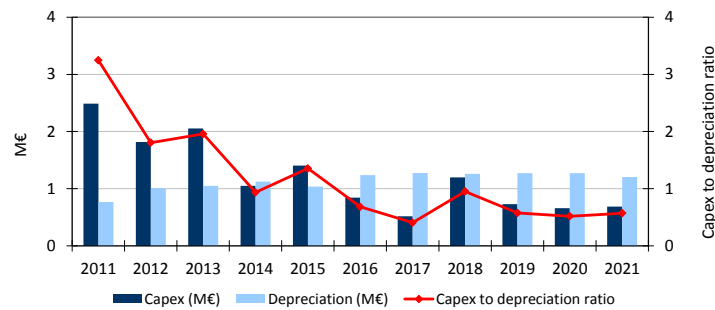


ARMATS (Armenia) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDP5	HMI	VCS
							C: 2013*	C: 2013*	C: 2013*	C: 2013*
						2011				
€2.4M						2012				
						2013				
						2014				
			€1.3M			2015				
			€0.5M			2016				
						2017				
		€2.3M				2018				
						2019				
			€2.5M (2020-2022)			2020				
						2021				

* C = Commissioning

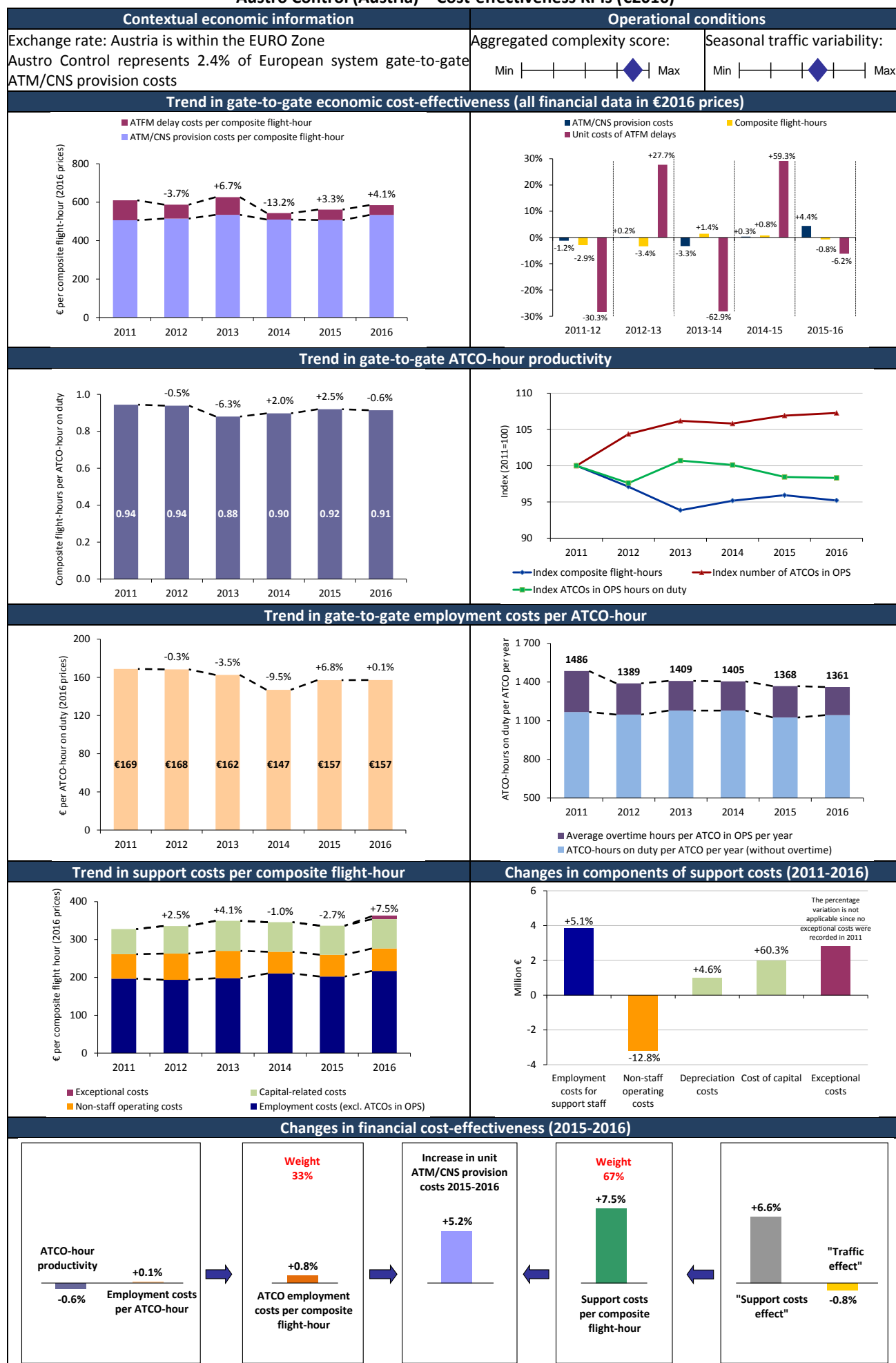
Upgrade

Replacement

Focus on the top five capex projects

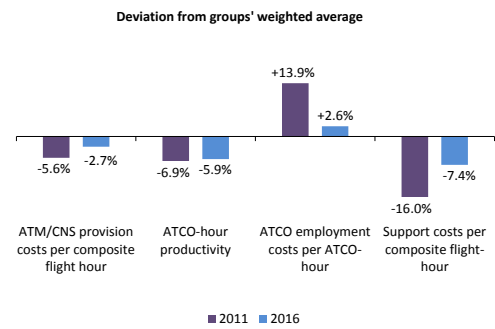
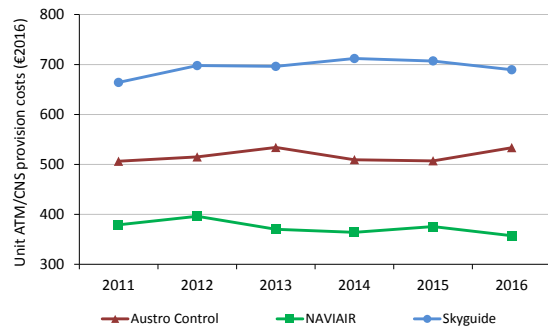
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Modernisation of ATC centre (ATM automated system and VCSS)	ATM	2.4	2012	2013
2	Procurement of a MSSR	SUR	1.4	2020	2021
3	Modernization of P3D surveillance system	SUR	1.3	2014	2016
4	Acquisition of MSPSR	SUR	1.1	2021	2022
5	Acquisition of GBAS	NAV	1.1	2019	2020

Austro Control (Austria) – Cost-effectiveness KPIs (€2016)

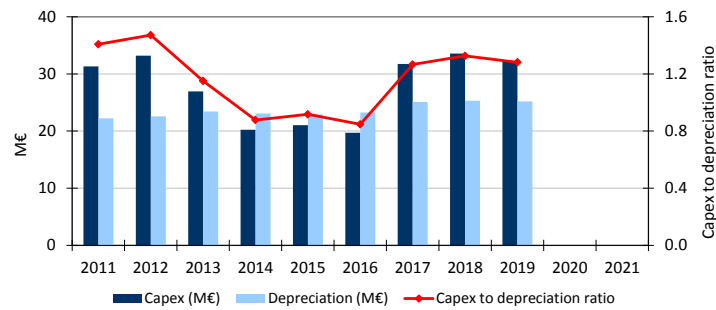


Austro Control (Austria) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2013*	C: 2013*	C: 2013*	C: 1996*
€33.6M		€4.3M	€10.3M	€13.6M (2010-2013)	€81.6M	2011				
	€4.2M					2012				
						2013				
						2014				
€68.0M	€23.7M	€11.4M	€10.5M	€27.3M	€24.7M	2015				
						2016				
						2017				
						2018				
						2019				
						2020				
						2021				

* C = Commissioning

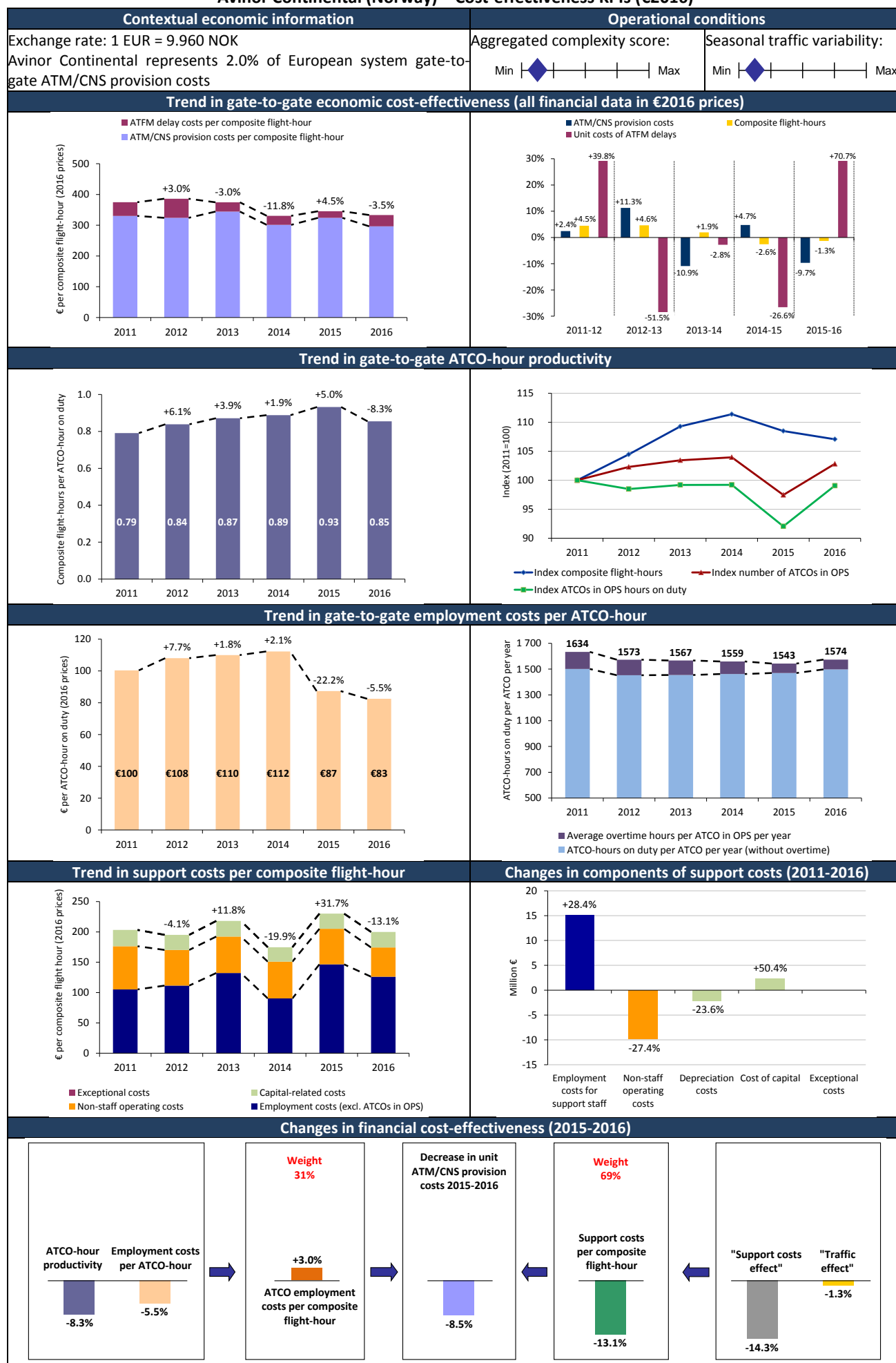
Upgrade

Replacement

Focus on the top five capex projects

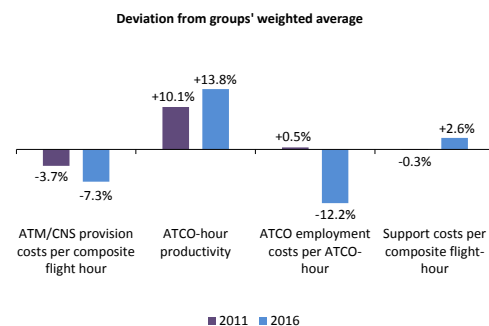
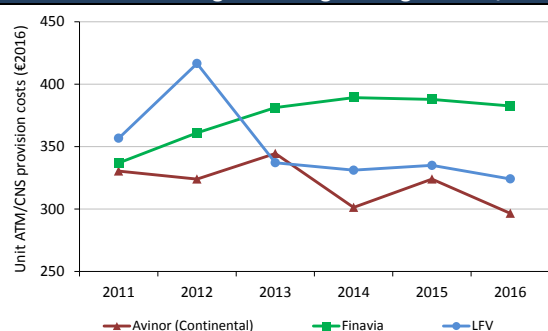
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Investment associated with ATM Systems (including COOPANS, training and simulator facilities, etc.)	ATM	101.6	2011	2019
2	Investments associated with buildings and facility management (including Salzburg airport TWR)	Buildings	40.9	2010	2019
3	Investment associated with communication (including introduction of CPDLC, VoIP technology, 8.33 kHz channel separation, etc.)	COM	27.9	2013	2019
4	Investments associated with surveillance (including upgrade to Mode-S in various locations, implementation of wide-area multilateration, etc.)	SUR	20.8	2011	2019
5	Investments associated with navigation (including upgrade of NAV infrastructure, replacement of ILS, VOR, and DME equipment, etc.)	NAV	15.7	2011	2019

Avinor Continental (Norway) – Cost-effectiveness KPIs (€2016)

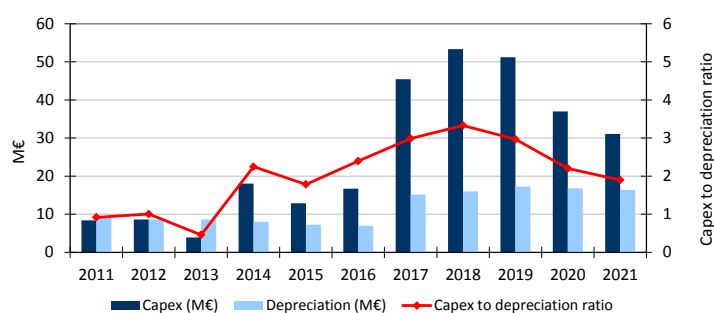


Avinor Continental (Norway) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

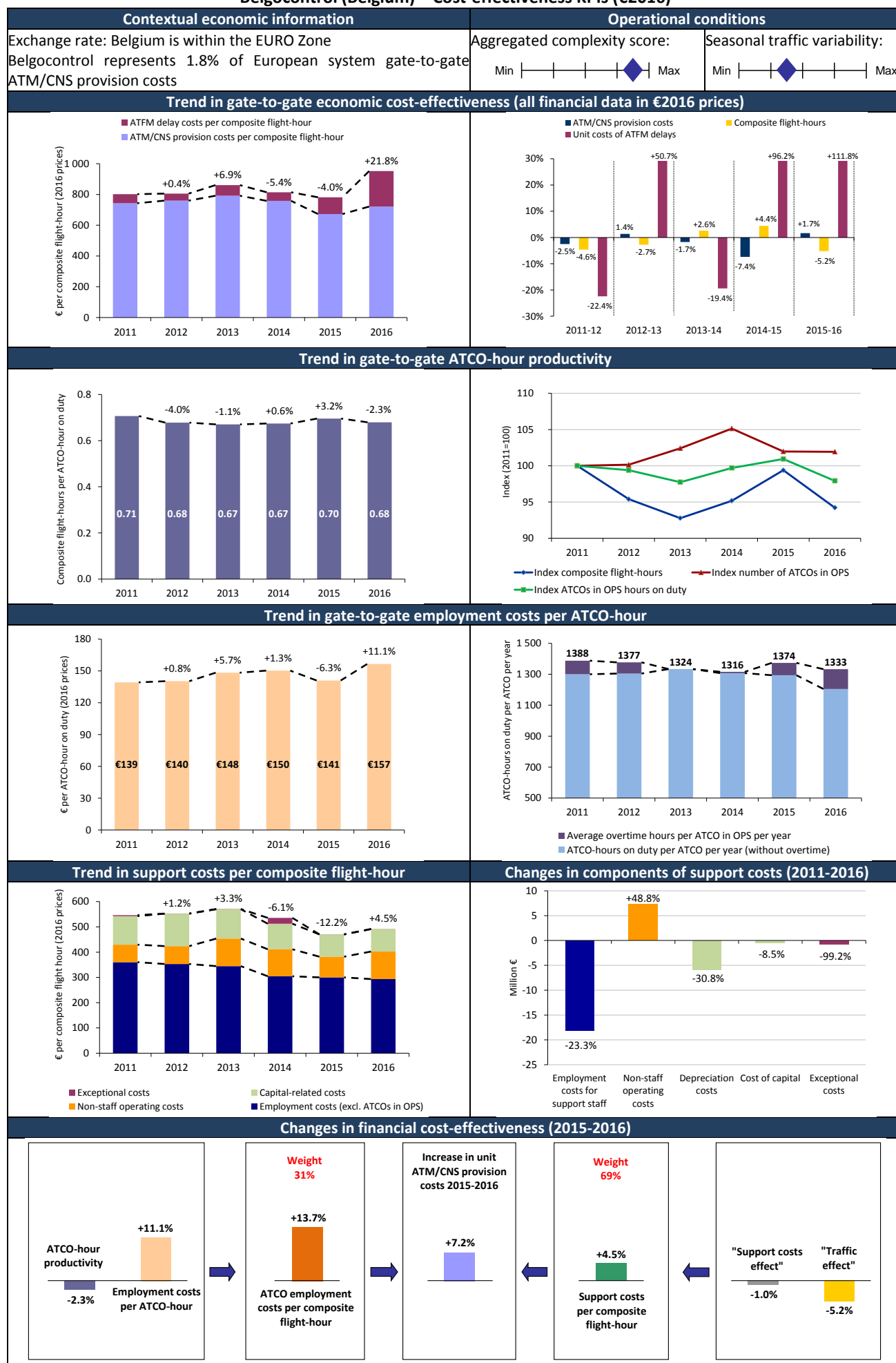
ATM	COM	NAV	SUR	Buildings	Other	Years	FDP5	RDPS	HMI	VCS
							C: 1996 (Oslo, Stavanger) 2008 (Bodø)*	C: 1996 (Oslo, Stavanger) 2008 (Bodø)*	C: 1996 (Oslo, Stavanger) 2008 (Bodø)*	C: 2009 (Oslo, Stavanger) 2008 (Bodø)*
€243.5M (2008-2022)	€2.9M		€40.5M (2010-2019)			2011				
						2012				Oslo
						2013				
						2014				Stavanger
	€10.3M	€1.8M		€2.6M	€1.6M	2015				
						2016	Oslo, Stavanger	Oslo, Stavanger	Oslo, Stavanger	
						2017	All ACCs	All ACCs	All ACCs	
						2018				
						2019				
						2020	Bodø	Bodø	Bodø	
						2021	Oslo, Stavanger	Oslo, Stavanger	Oslo, Stavanger	

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

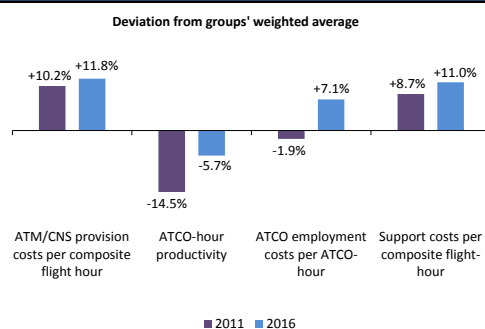
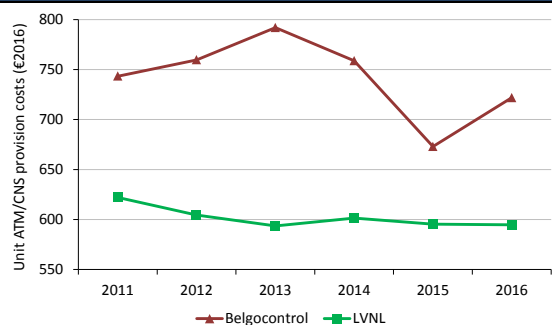
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Remote Towers	ATM	116.5	2015	2020
2	New ATM infrastructure (FAS ACC)	ATM	85.9	2016	2022
3	Norwegian Wide Area Multilateration (NORWAM)	SUR	23.3	2013	2019
4	SNAP (Southern Norway Airspace Project) project	ATM	12.6	2008	2016
5	Free Route Airspace	ATM	11.9	2014	2017

Belgocontrol (Belgium) – Cost-effectiveness KPIs (€2016)

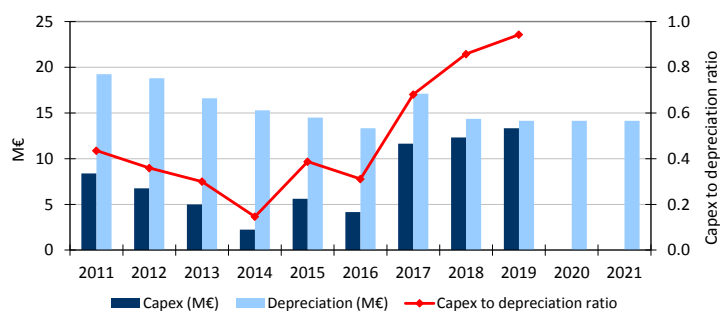


Belgocontrol (Belgium) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

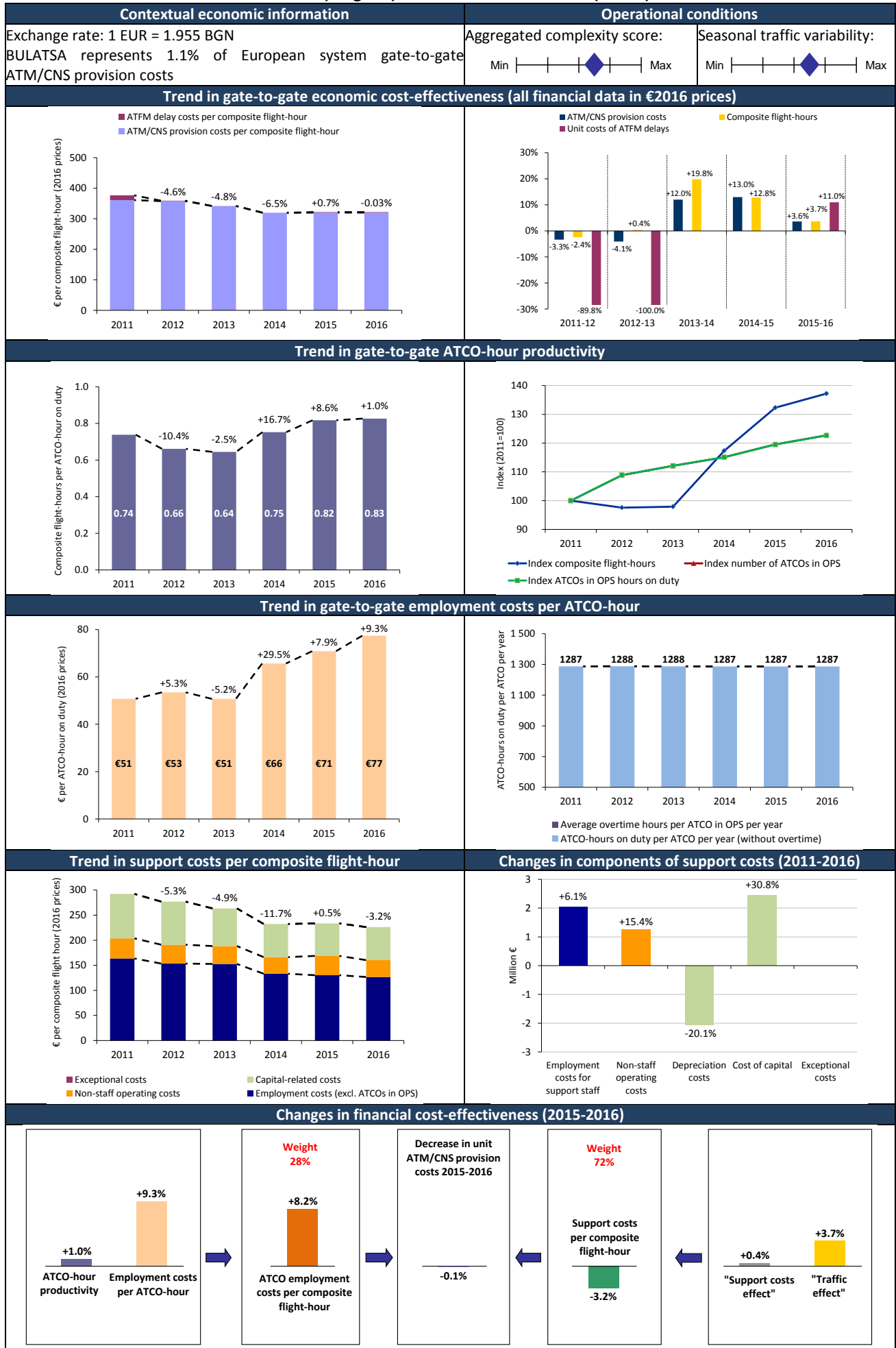
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2009*	C: 2004*	C: 2009*	C: 2008-2009*
€24.8M (Continuous investment)	€7.7M	€28.5M (2010-2027)	€33.3M (2010-2020)		€36.2M (2010-2020)	2011				
						2012				
						2013				
						2014				
						2015				
						2016				
						2017				
						2018				
						2019				
						2020	(2020-2025)		(2020-2025)	
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

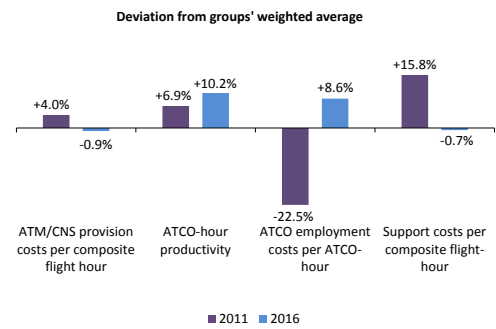
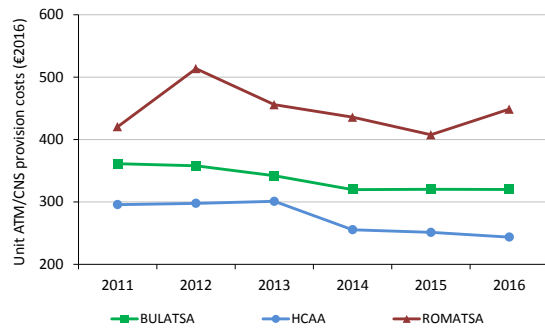
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Continuous evolution of the ATM system (Canac 2 A/S RFC)	ATM	23.8	2011	Continuous investment
2	ILS at the Brussels, Liège, Ostend, Charleroi and Antwerp Airports	NAV	15.3	2018	2027
3	A-SMGCS at Liège and Charleroi airports	SUR	10.4	2015	2019
4	Replacement of approach radars at Brussels, Ostende and Charleroi airports	SUR	10.2	2010	2019
5	Replacement and overhaul of VOR and DME equipment	NAV	7.4	2010	2018

BULATSA (Bulgaria) – Cost-effectiveness KPIs (€2016)

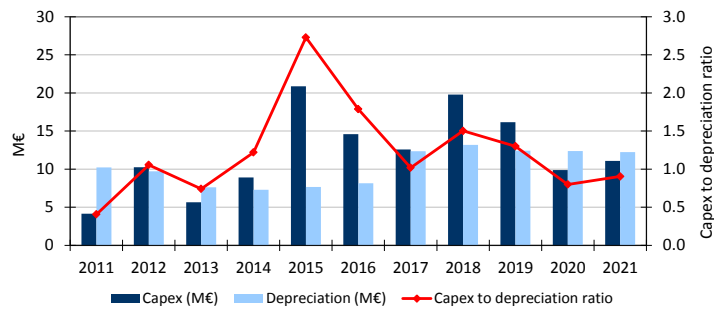


BULATSA (Bulgaria) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

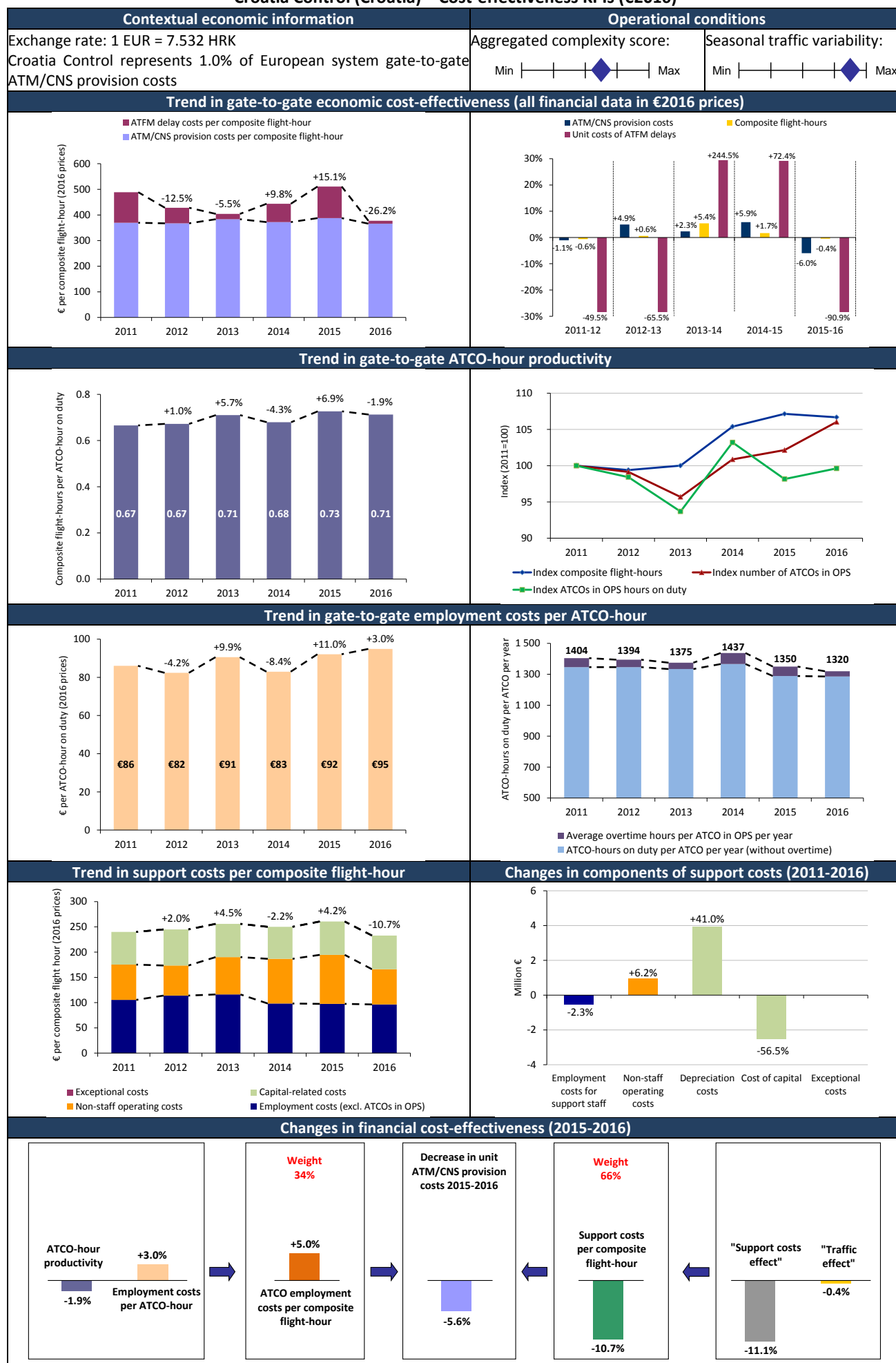
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2005*	C: 2005*	C: 2005*	C: 2015*
€54.2M (2009-2022)	€8.1M	€4.0M	€24.9M	€7.9M (2009-2013)		2011				
						2012				
						2013				
						2014				
				€1.3M		2015				
						2016				
						2017				
					€2.5M	2018				
						2019				
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

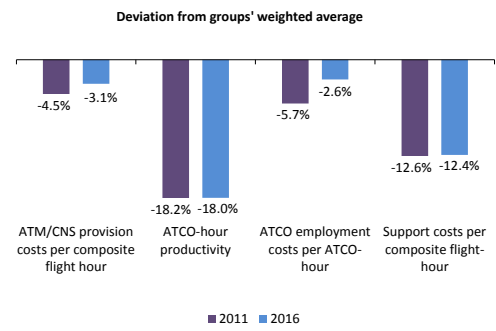
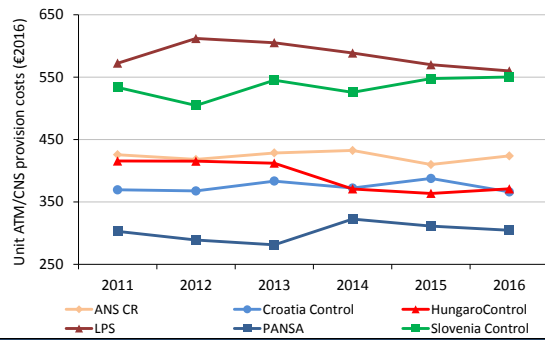
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	New ATM system (incl. en-route AMAN)	ATM	34.0	2018	2022
2	Modernisation of surveillance infrastructure (Mode S & PSR)	SUR	13.5	2014	2017
3	New tower at Sofia airport and its adjacent structure	Buildings	7.9	2009	2013
4	SATCAS ATM System Upgrade	ATM	5.8	2014	2016
5	Extension and upgrade of the SATCAS system	ATM	5.2	2009	2013

Croatia Control (Croatia) – Cost-effectiveness KPIs (€2016)

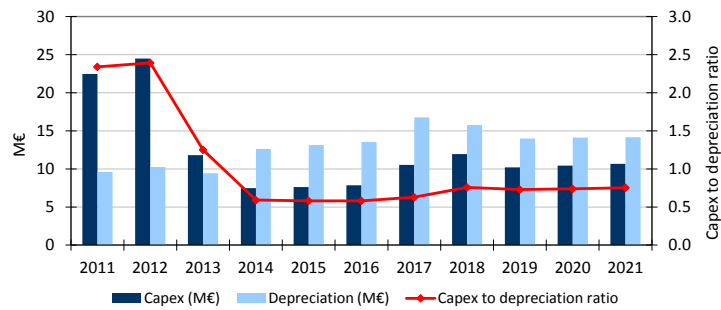


Croatia Control (Croatia) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2014*	C: 2014*	C: 2014*	C: 2014*
						2011				
						2012				
						2013				
						2014				
						2015				
						2016				
						2017				
						2018				
						2019				
						2020				
						2021				

* C = Commissioning

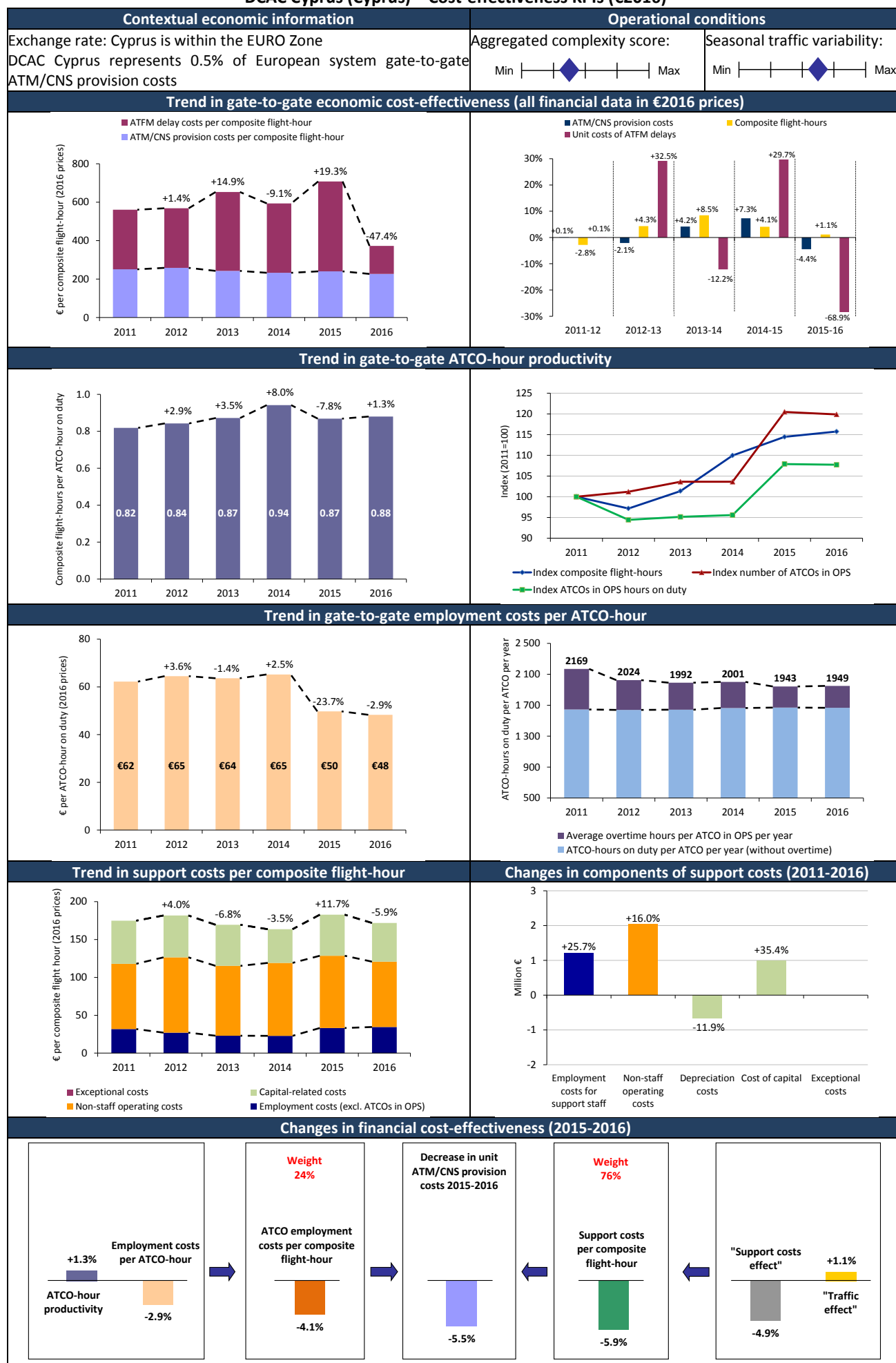
Upgrade

Replacement

Focus on the top five capex projects

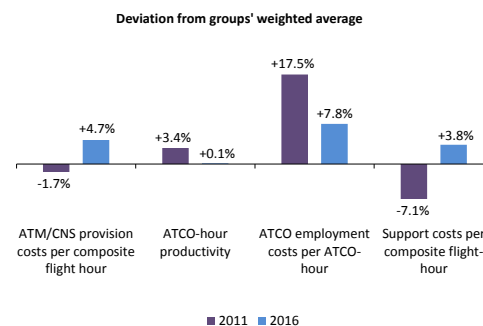
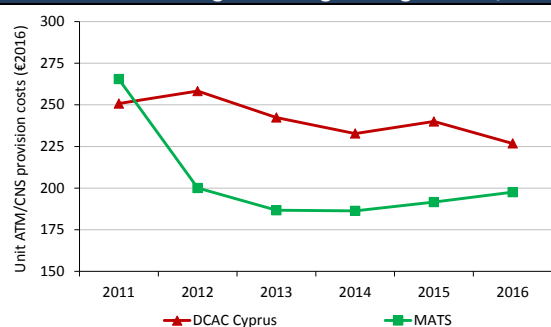
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Investment associated with ATM systems (including upgrade of CroATM/COOPANS system and other ATM domain related capex)	ATM	65.2	2011	2019
2	Investment associated with communication (including upgrade of DATA-COM, VOICE-COM and other COM domain related capex)	COM	19.2	2011	2019
3	Investment associated with navigation	NAV	5.2	2011	2019
4	Investment associated with surveillance	SUR	7.2	2011	2019
5	Investment associated with buildings and facility management	Buildings	5.1	2011	2019

DCAC Cyprus (Cyprus) – Cost-effectiveness KPIs (€2016)

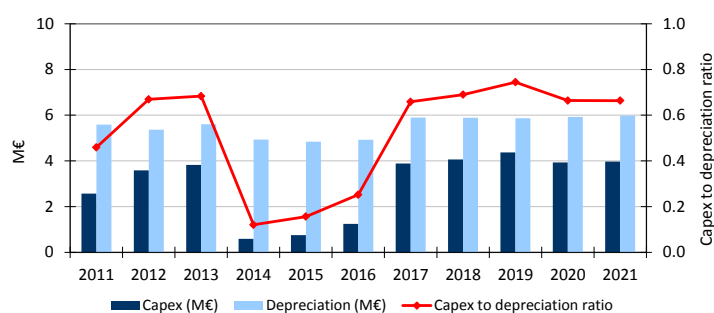


DCAC Cyprus (Cyprus) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

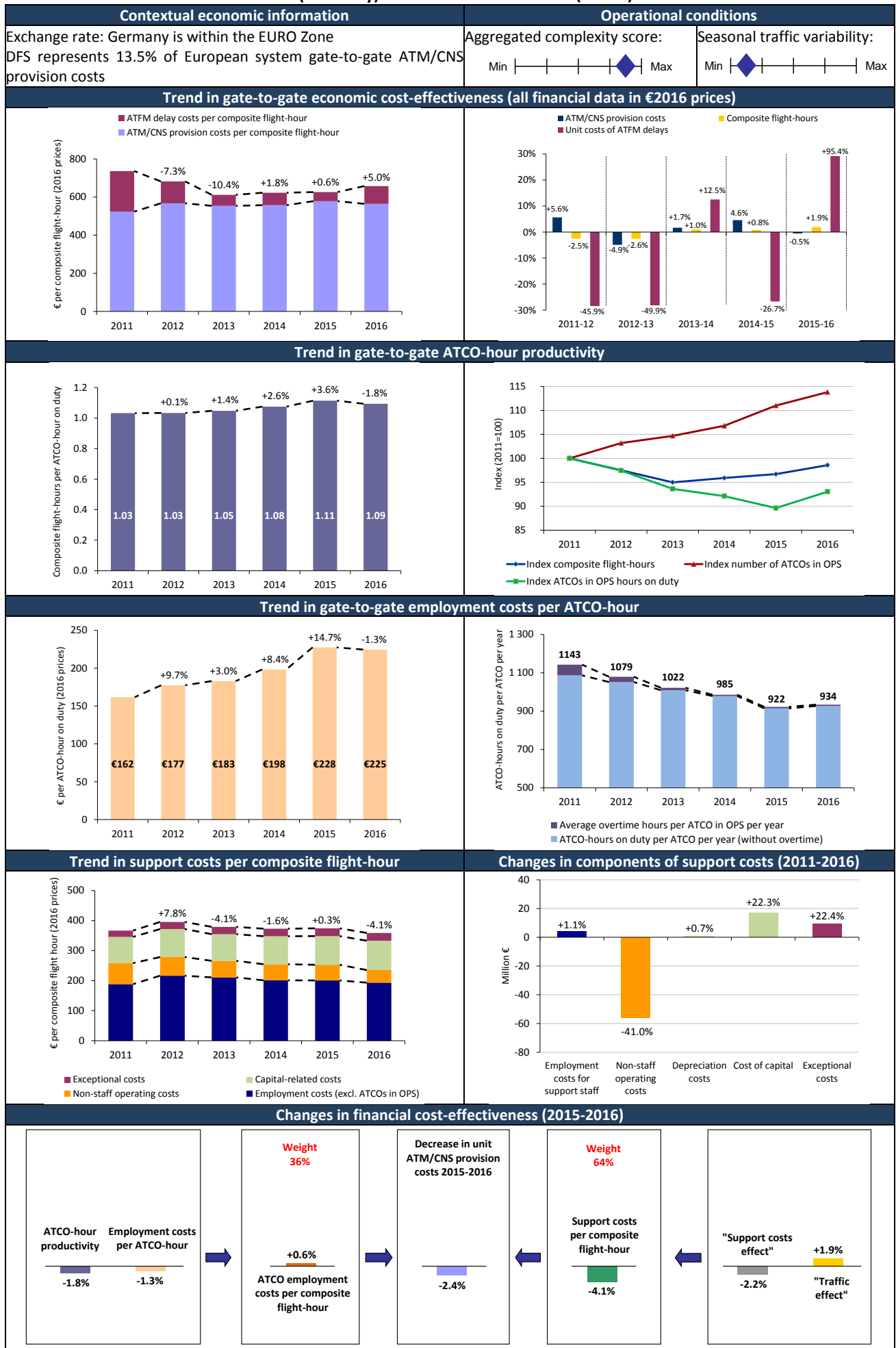
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2013*	C: 2013*	C: 2013*	C: 1998*
€5.1M		€0.3M	€13.0M (2006-2018)			2011				
					2012					
	€1.4M			2013						
				2014						
				2015						
€10.2M	€6.2M	€3.0M				2016				
						2017				
						2018				
					€1.0M		2019			
						2020				
					2021					

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

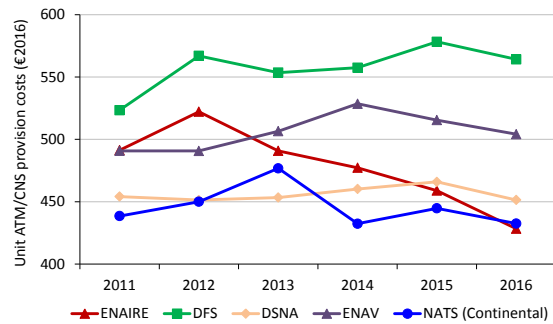
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Top Sky	ATM	9.5	2018	2019
2	Radar updates in Kiona	SUR	8.4	2006	2014
3	DATALINK	COM	4.0	2017	2018
4	Replacement of Lara SSR and installation of SSR at Pafos	SUR	2.6	2016	2018
5	Eurocat C to main - Top Sky	ATM	2.5	2013	2015

DFS (Germany) – Cost-effectiveness KPIs (€2016)

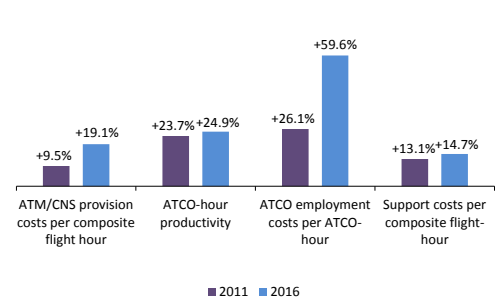


DFS (Germany) – (€2016)

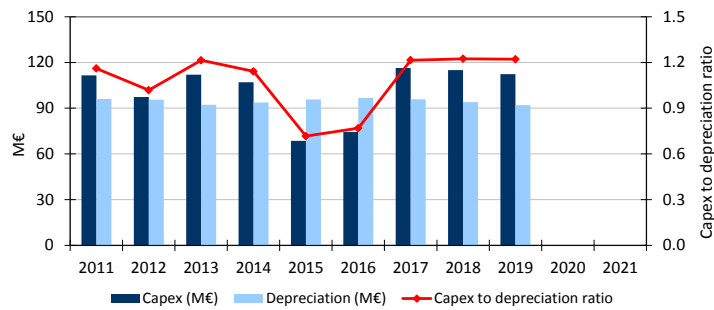
Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Deviation from groups' weighted average



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2010 (Karl.) 2004 (Bremen) 1999 (Langen) 1999 (München)*	C: 2010 (Karl.) 2004 (Bremen) 1999 (Langen) 1999 (München)*	C: 2010 (Karl.) 2008 (Bremen) 2013 (Langen) 2011 (München)*	C: 2009 (Karl.) 2003 (Bremen) 2013 (Langen) 2016 (München)*
€429.4 M (2004-2024)	€129.8 M (2007-2022)	€55.6 M (1999-2022)	€240.1 M (2006-2032)	€161.0 M (2002-2018)	€50.8 M (2011-2017)	2011			München	
						2012				
						2013			Langen	Langen
						2014	Bremen	Bremen	Bremen	
						2015	Karlsruhe, Langen	Langen	Karlsruhe, München	Langen
						2016	München	München		München
						2017	Karlsruhe	Karlsruhe	Karlsruhe, Langen	Bremen
						2018				
						2019				
						2020	Bremen, München	Bremen, München	Bremen, München	München
						2021				

* C = Commissioning

Upgrade

Replacement

Focus on the top five capex projects

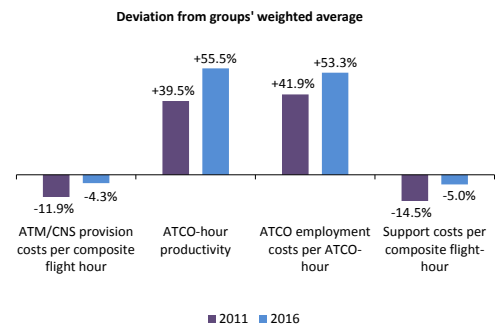
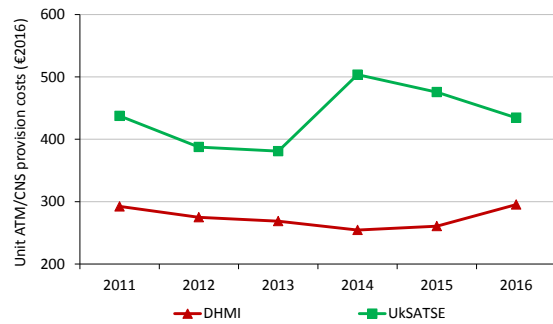
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Programme iCAS	ATM	282.8	2006	2023
2	MaRS - Modernisation and Replacement of Surveillance Infrastructure	SUR	217.9	2012	2032
3	Rasum 8.33 kHz	COM	81.5	2007	2022
4	Extension of Munich ACC	Buildings	51.8	2008	2016
5	Technical Centre Campus Langen	Buildings	49.7	2009	2017

DHMI (Turkey) – Cost-effectiveness KPIs (€2016)

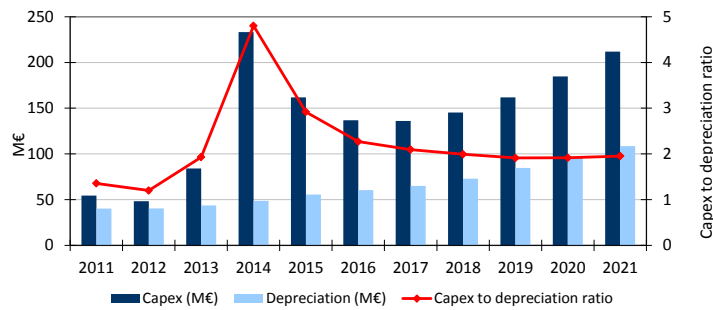


DHMI (Turkey) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2015 (All ACCs)*	C: 2015 (All ACCs)*	C: 2015 (All ACCs)*	C: 2015 (All ACCs)*
€212.9M (2008-2021)		€141.3M (2010-2020)	€150.9M (2008-2023)	€71.5M (2008-2019)		2011				All ACCs
						2012	All ACCs	All ACCs	All ACCs	
					€4.2M	2013				
						2014				
						2015	All ACCs	All ACCs	All ACCs	All ACCs
						2016				
						2017				
						2018				
	€53.9M					2019				
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	SMART (Systematic Modernization of ATM Resources in Turkey)	ATM	91.6	2008	2016
2	Air navigation, communication and terminal systems periodic modernisation	NAV	83.4	2010	2020
3	Procurement, Installation and Modernization of Surveillance and ATC Systems	SUR	67.5	2015	2023
4	Purchase of 2 calibration aircrafts	COM	53.9	2018	2020
5	Construction of air navigation technical blocks	Buildings	53.5	2008	2019

DSNA (France) – Cost-effectiveness KPIs (€2016)

Contextual economic information

Exchange rate: France is within the EURO Zone
DSNA represents 15.5% of European system gate-to-gate ATM/CNS provision costs

Operational conditions

Aggregated complexity score:
Min |-----| Max

Seasonal traffic variability:
Min |-----| Max

Trend in gate-to-gate economic cost-effectiveness (all financial data in €2016 prices)

Year	Cost (€)	% Change
2011	~500	-
2012	~510	+0.6%
2013	~505	-0.03%
2014	~520	+2.5%
2015	~550	+5.5%
2016	~580	+7.7%

Period	Cost (%)
2011-12	+8.1%
2012-13	+0.3%
2013-14	+2.1%
2014-15	+8.3%
2015-16	+55.3%

Trend in gate-to-gate ATCO-hour productivity

Year	Productivity	% Change
2011	0.74	-
2012	0.76	+1.8%
2013	0.75	-1.0%
2014	0.74	-1.3%
2015	0.77	+3.5%
2016	0.76	-1.1%

Trend in gate-to-gate employment costs per ATCO-hour

Year	Hours
2011	1304
2012	1258
2013	1284
2014	1284
2015	1284
2016	1284

Year	Cost (€)	% Change
2011	~95	-
2012	~99	+2.9%
2013	~99	-0.6%
2014	~100	+1.1%
2015	~100	+0.4%
2016	~101	+0.9%

Trend in support costs per composite flight-hour

Year	Total Cost (€)	% Change
2011	~320	-
2012	~280	-1.3%
2013	~300	+0.5%
2014	~320	+1.2%
2015	~340	+3.0%
2016	~320	-5.2%

Changes in components of support costs (2011-2016)

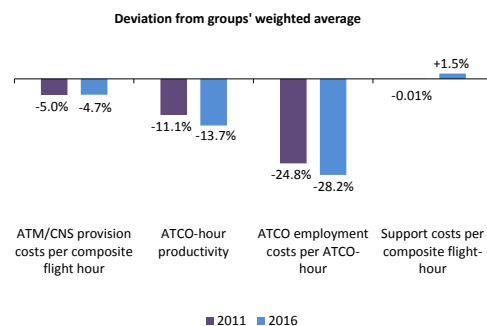
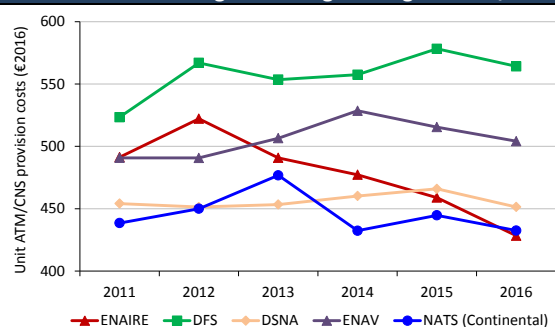
Changes in financial cost-effectiveness (2015-2016)

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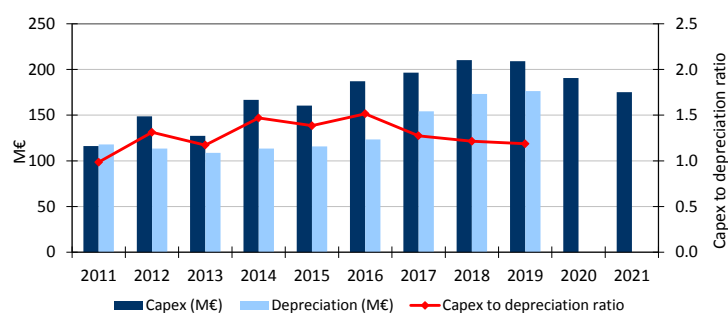
graph LR
    A["ATCO-hour productivity: -1.1%"] --> B["Employment costs per ATCO-hour: +0.9%"]
    B --> C["ATCO employment costs per composite flight-hour: +2.1%"]
    C --> D["Decrease in unit ATM/CNS provision costs 2015-2016: -3.1%"]
    E["Support costs per composite flight-hour: -5.2%"] --> D
    F["'Support costs effect': -1.7%"] --> G["'Traffic effect': +3.7%"]
    G --> H["Total effect: +0.9%"]
  
```


DSNA (France) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

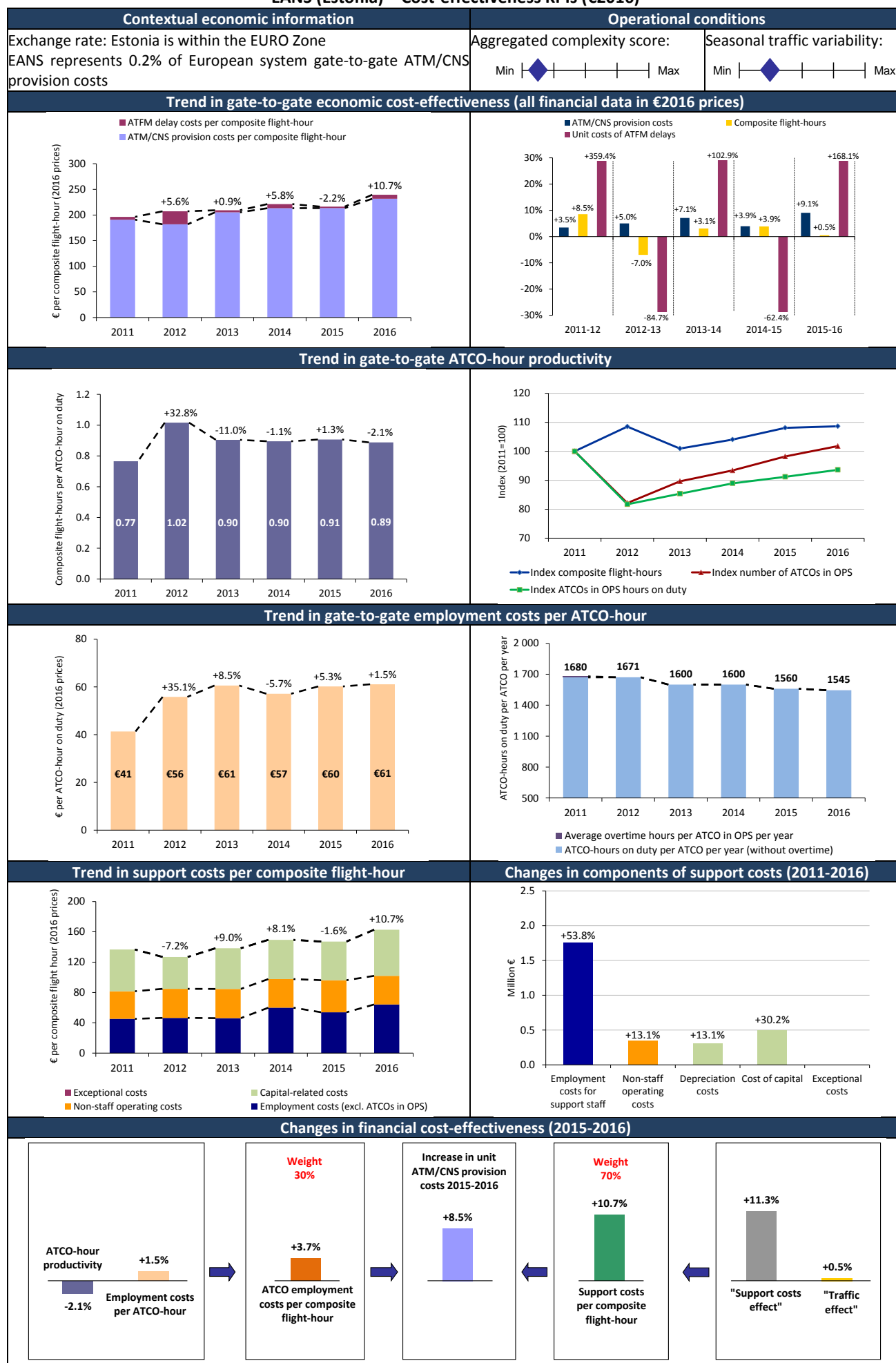
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 1982 (All ACCs)*	C: 1982 (All ACCs)*	C: 2000 (All ACCs)*	C: 2000/2003 (All ACCs)*
€1 254.8M (2003-2025)	€206.6M (2003-2023)	€16.4M	€26.0M		€343.6M	2011				
						2012				
						2013				
						2014				
						2015				
						2016			Bordeaux, Brest	
						2017				
						2018				
						2019	Marseille, Reims	Marseille, Reims	Marseille, Reims	
						2020	Paris	Paris	Paris	
						2021	Bordeaux, Brest	Bordeaux, Brest	Bordeaux, Brest	

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

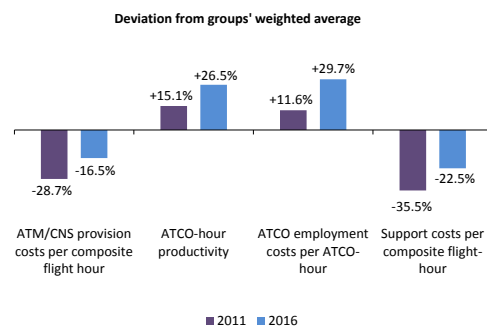
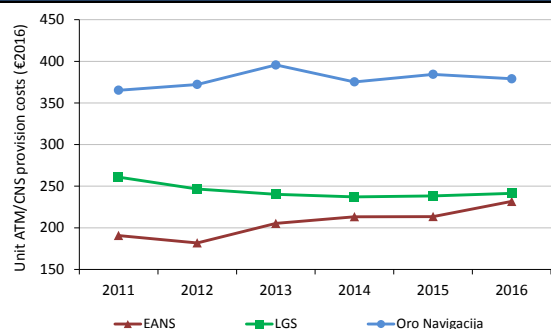
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	4-FLIGHT (New ATM system integrating COFLIGHT, Java HMI and advanced ATC tools in an electronic environment)	ATM	550.0	2003	2022
2	COFLIGHT (Automatic flight plan processing system forming the core of 4-flight)	ATM	273.6	2003	2022
3	SYSAT (systems for APP and TWR)	ATM	248.0	2012	2025
4	ERATO (stripless system designed in an all-electronic environment with innovative MTCD functionalities)	ATM	118.2	2003	2022
5	Maintenance and evolution of existing installations in NAV / COM / ATM domains	OTHER	113.4	2015	2019

EANS (Estonia) – Cost-effectiveness KPIs (€2016)

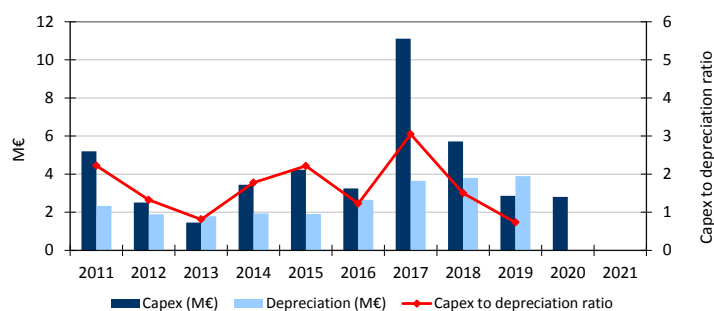


EANS (Estonia) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2012*	C: 2012*	C: 2012*	C: 2012*
€8.0M (2009-2012)		€1.0M (2010-2012)		€0.2M		2011				
						2012				
						2013				
						2014				
						2015				
						2016				
€7.5M	€1.6M	€0.5M	€1.5M	€0.5M	€0.7M	2017				
						2018				
						2019				
						2020				
						2021				

* C = Commissioning

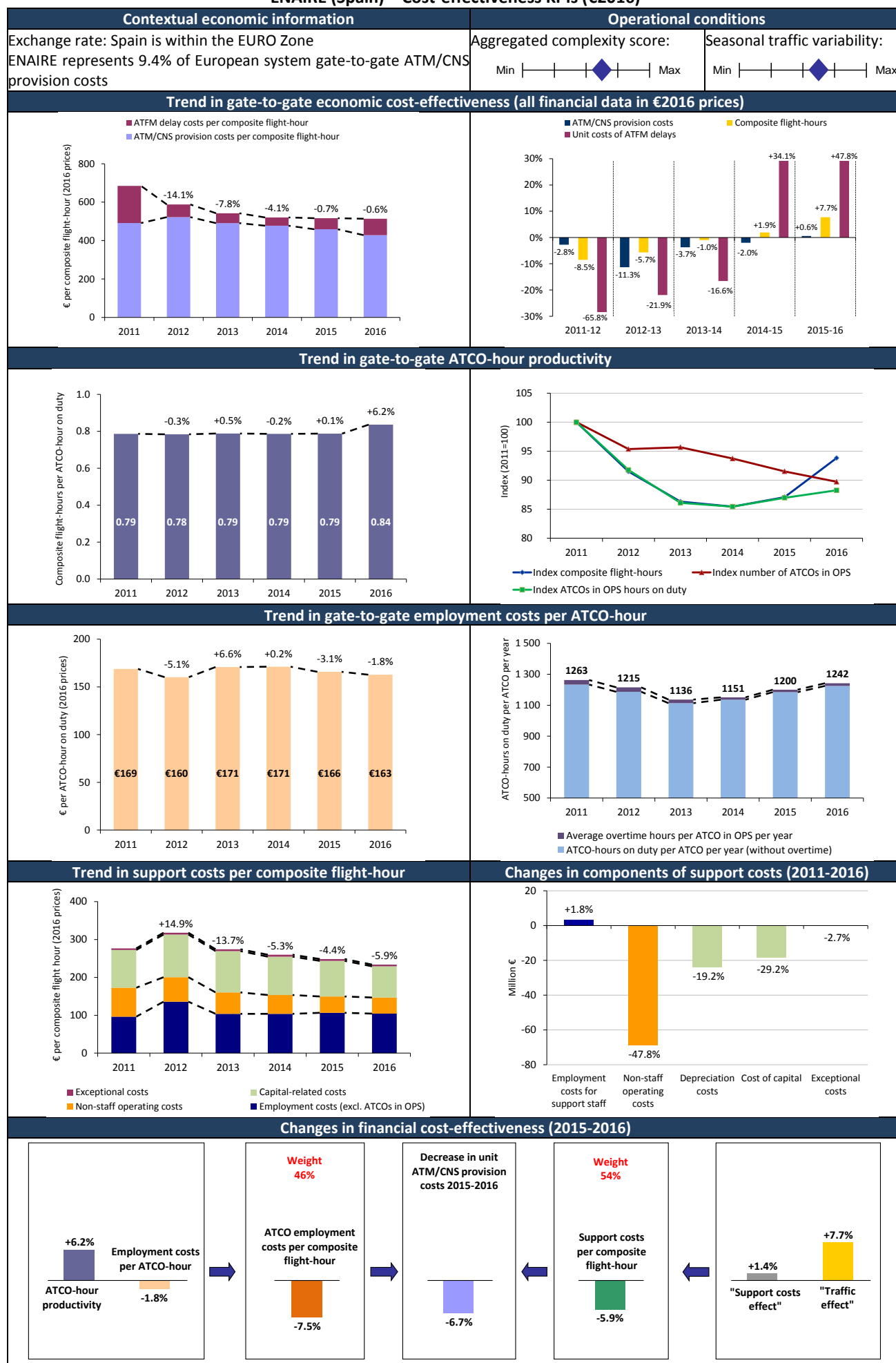
Upgrade

Replacement

Focus on the top five capex projects

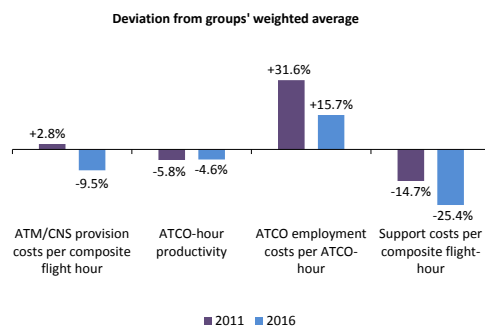
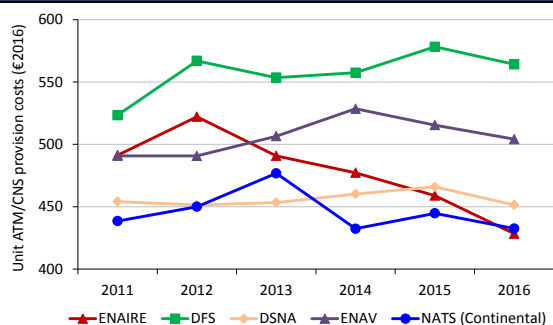
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Replacement EUROCAT ATM system in Tallinn ACC (including new ATCO HMI)	ATM	8.0	2009	2012
2	Expenses in ATM system covering: Cross-border operations, FRA, FUA, data recording/storage, CPDLC, messages exchange with CFMU, Tallinn Airport operations, FASTI tools, software environment for management processes	ATM	7.5	2015	2019
3	Communication, including: G-G voice upgrade with St-Petersburg ATCC, implementation of DTIS and DLC messages for Tallinn airport	COM	1.6	2015	2019
4	Expenses in surveillance, including: expansion of Tallinn airport SMR-MLAT infrastructure, exchange of surveillance data, installation of Tallinn FIR WAM system	SUR	1.5	2015	2019
5	Implementation of P-RNAV	NAV	1.0	2010	2012

ENAIRE (Spain) – Cost-effectiveness KPIs (€2016)

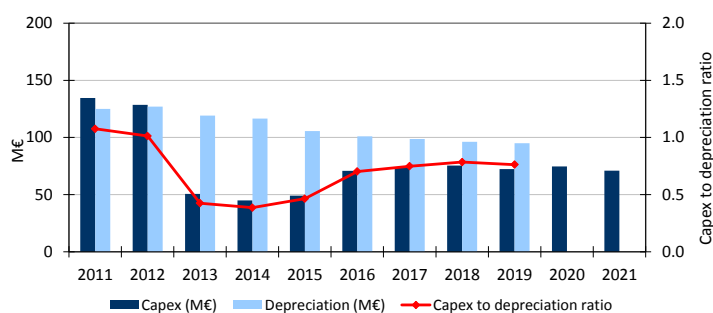


ENAIRE (Spain) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPs	RDPS	HMI	VCS
							C: 2006 (all ACCs)*	C: 2006 (all ACCs)*	C: 2006 (all ACCs)*	C: 2014 Canarias TMA & En-route 2000 (other ACCs-TMA) 2002 (other ACCs-En-route)*
						2011				Madrid, Sevilla
						2012	All ACCs	All ACCs	All ACCs	
						2013				
						2014				Canarias
						2015				
						2016	Canarias	Canarias	Canarias	Canarias
						2017	Barcelona, Madrid, Palma, Sevilla	Barcelona, Madrid, Palma, Sevilla	Barcelona, Madrid, Palma, Sevilla	Canarias
						2018	Canarias	Canarias	Canarias	
						2019				Madrid
						2020				
						2021				Barcelona

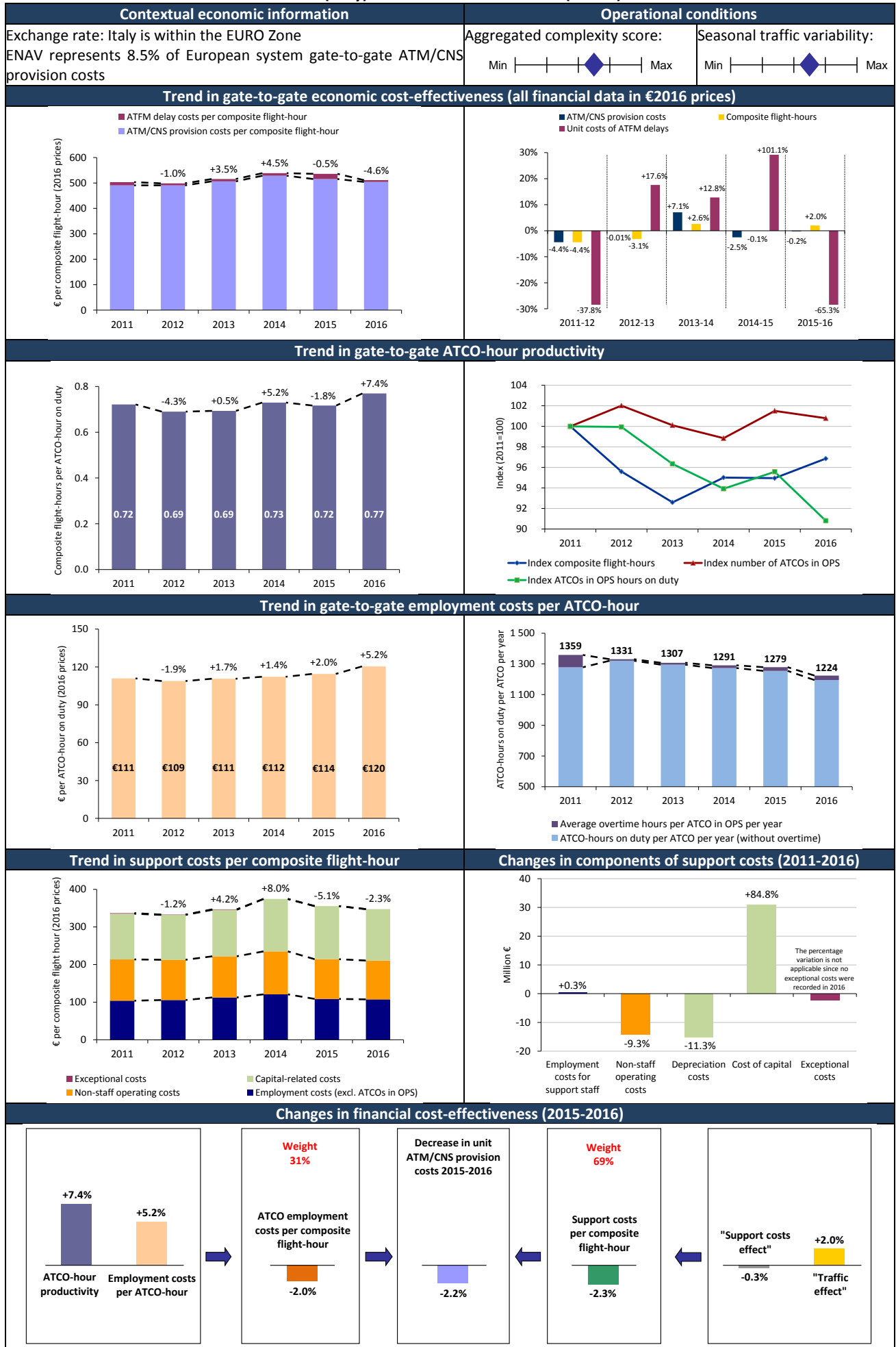
* C = Commissioning Upgrade Replacement

**Information on major capex projects is based on data provided in South West FAB National Performance Plan for RP2 (2015-2019)

Focus on the top five capex projects

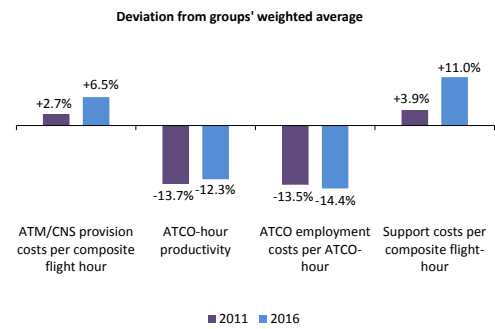
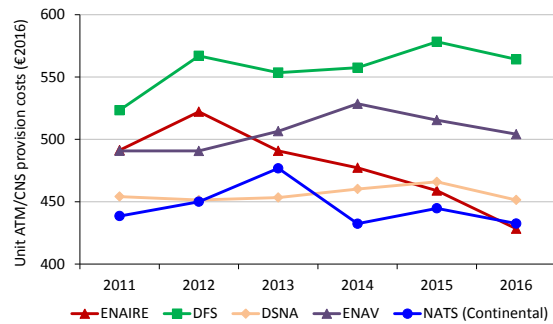
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	iTEC – Flight Data Processing	ATM/NAV	50.8	2015	2019
2	COMETA – Voice over Internet Protocol	ATM/NAV	42.8	2015	2019
3	SURVEILLANCE EVOLUTION – Mode-S, ADS-B	SUR	17.8	2015	2019
4	REDAN – Data Network	ATM/COM/NAV	16.1	2015	2019
5	8.33 – Communication Channels	ATM/COM/NAV	11.4	2015	2018

ENAV (Italy) – Cost-effectiveness KPIs (€2016)

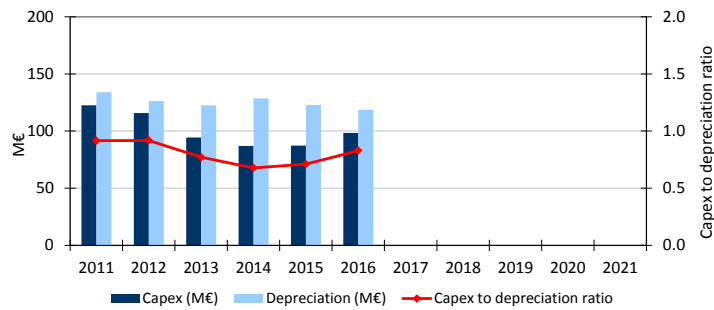


ENAV (Italy) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS C: 1999 (All ACCs)*	RDP5 C: 1999 (All ACCs)*	HMI C: 1999 (All ACCs)*	VCS C: 2000 (Roma) 2001 (Padova) 2005 (Brin. and Mil.)*
						2011				
						2012				
						2013	Roma	Roma	Roma	Roma
						2014	Padova, Milano	Padova, Milano	Padova, Milano	Padova, Milano
						2015	Brindisi	Brindisi	Brindisi	Brindisi
						2016	Roma, Padova, Brindisi, Milano	Roma, Padova, Brindisi, Milano	Roma, Padova, Brindisi, Milano	Roma, Padova, Brindisi, Milano
€133.6M	€23.6M		€18.9M		€236.1M	2017				
						2018				
						2019	All ACCs	All ACCs	All ACCs	All ACCs
						2020				
						2021				

* C = Commissioning

Upgrade

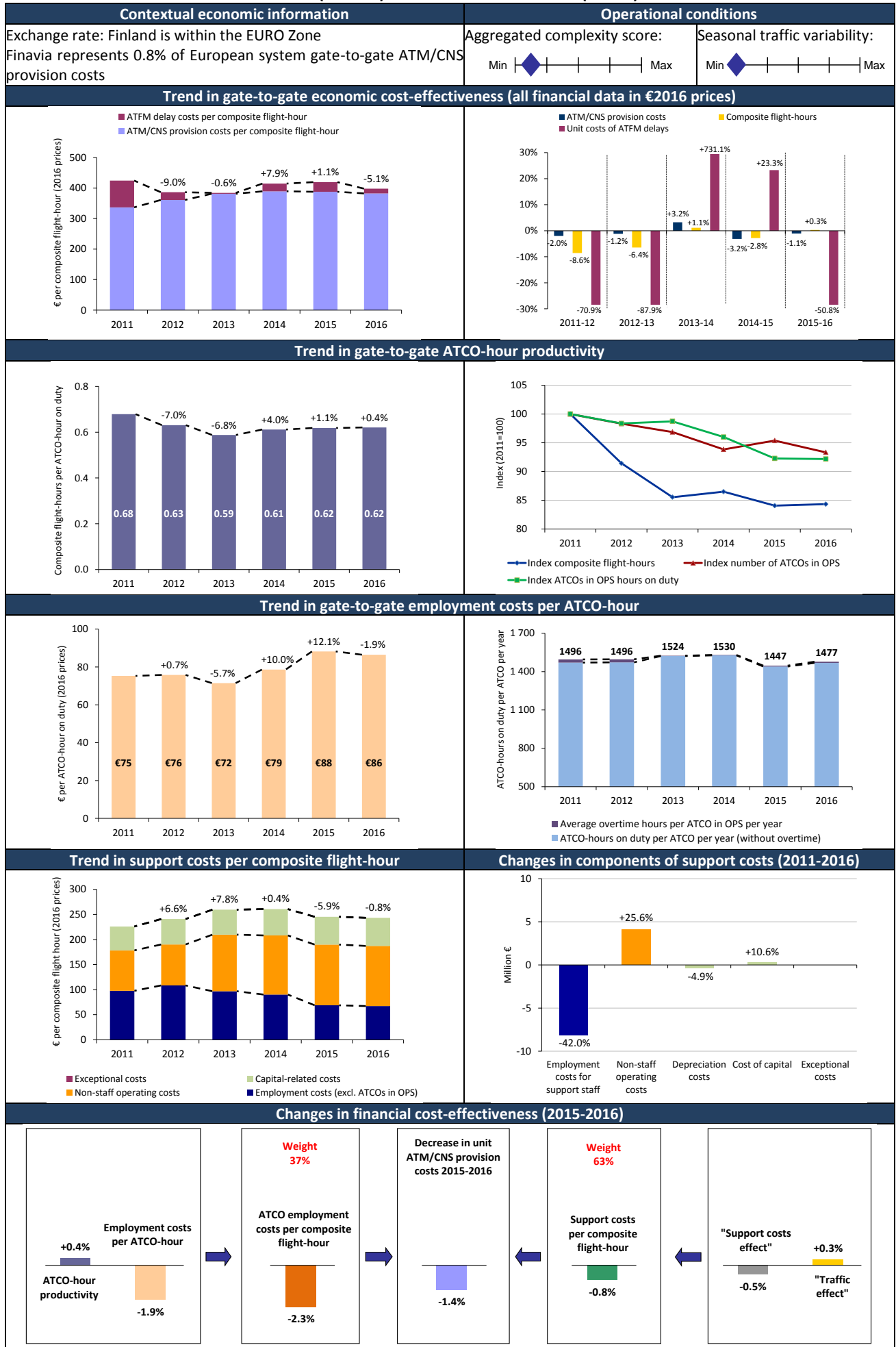
Replacement

**Information on major capex projects is based on data provided in Blue Med FAB National Performance Plan for RP2 (2017-2019)

Focus on the top five capex projects

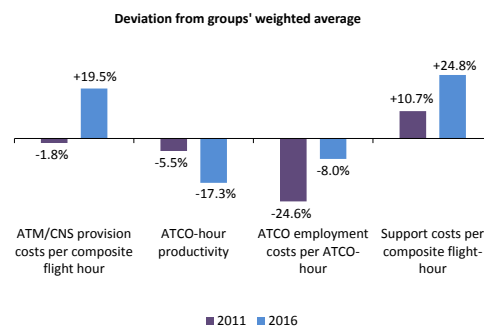
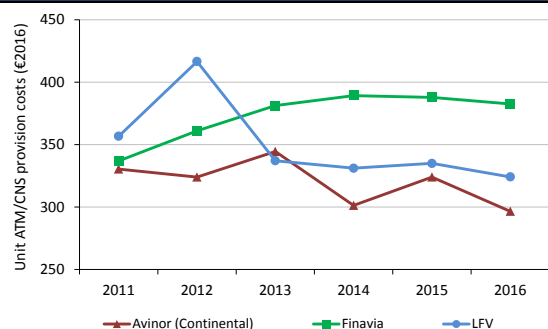
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Development of an integrated platform for the management of ATM procedures and aeronautical data (program 4-FLIGHT)	ATM	99.7	2017	2019
2	COFLIGHT (Automatic flight plan processing system forming the core of 4-FLIGHT)	ATM	17.5	2017	2019
3	ENET + ENET Completion	COM	11.2	2017	2019
4	Advanced Surface Movement Guidance and Control System Level 2	SUR	8.5	2017	2019
5	TBT 8.33 KH completion below FL195	COM	7.6	2017	2019

Finavia (Finland) – Cost-effectiveness KPIs (€2016)

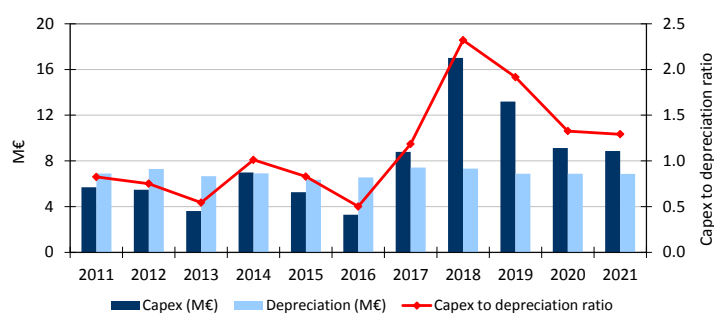


Finavia (Finland) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

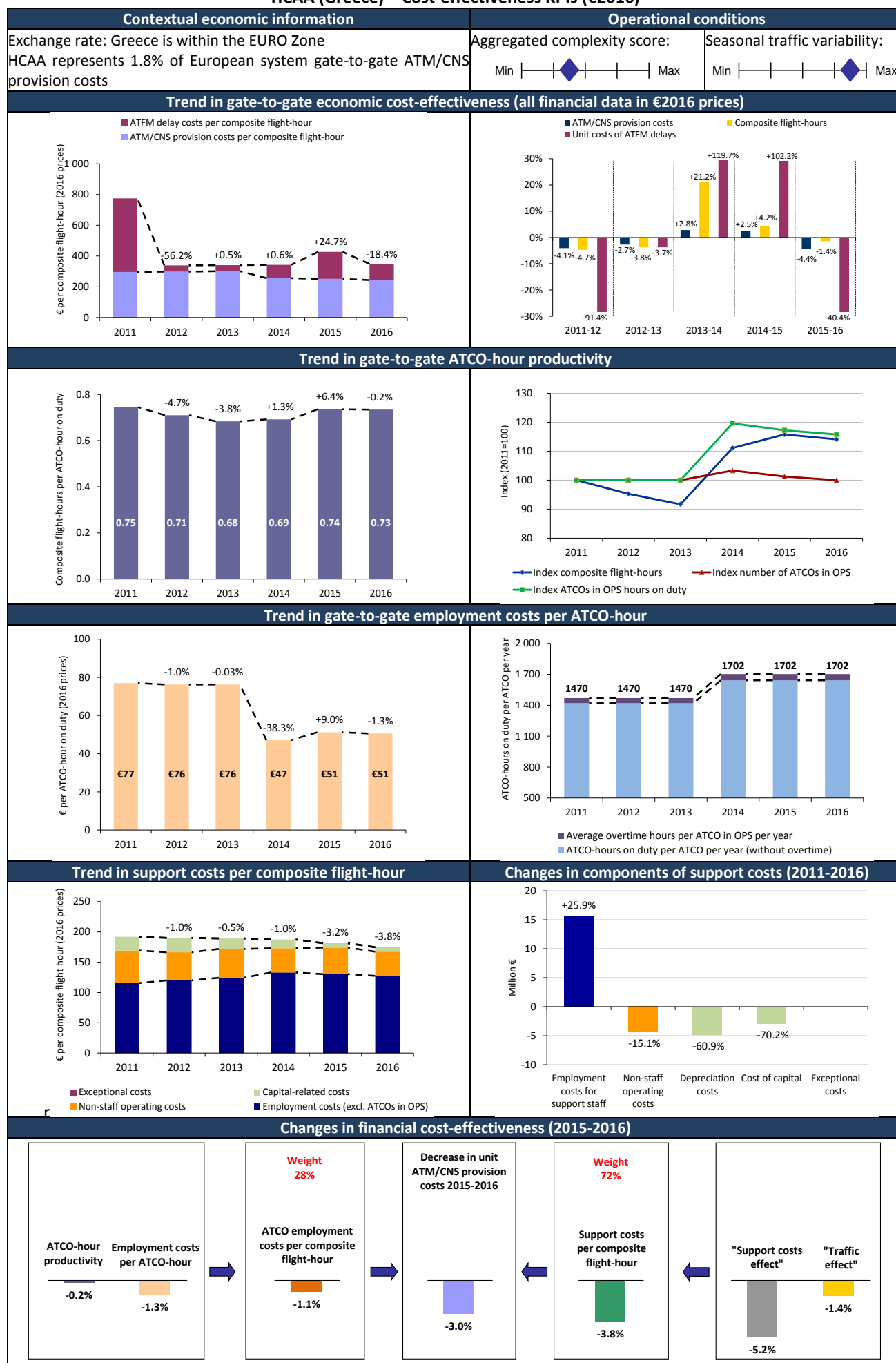
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2005*	C: 2005*	C: 2005*	C: 2009*
€13.8M (2009-2013)	€1.0M					2011				
						2012				
						2013				
						2014				
						2015				
€43.2M			€21.4M (2011-2023)			2016				
	€14.4M	€12.7M		€1.0M		2017				
					€1.8M	2018				
						2019				
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

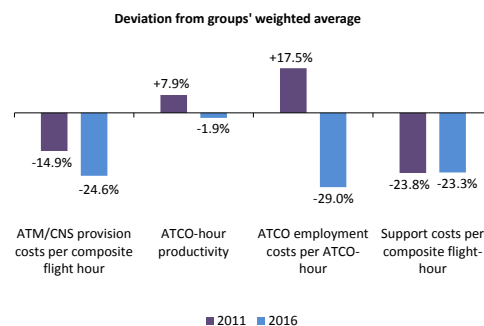
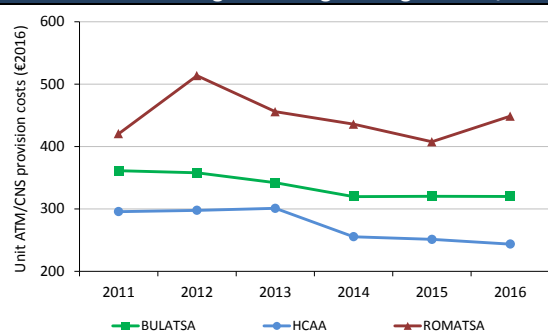
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	ATM system upgrades	ATM	19.0	2017	2021
2	Replacement of ATM systems at Tampere and Helsinki Centres	ATM	13.8	2009	2013
3	ILS/DME renewal (all airports)	NAV	10.4	2014	2019
4	MSSR-renewal for Helsinki, Rovaniemi, Tampere-Pirkkala, Kuopio, Jyväskylä and Turku airports	SUR	9.6	2018	2023
5	Investments in Wide Area Multilateration (WAM) technology	SUR	9.0	2011	2020

HCAA (Greece) – Cost-effectiveness KPIs (€2016)

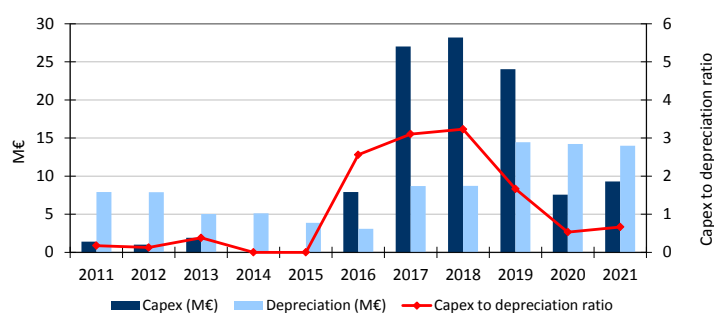


HCAA (Greece) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

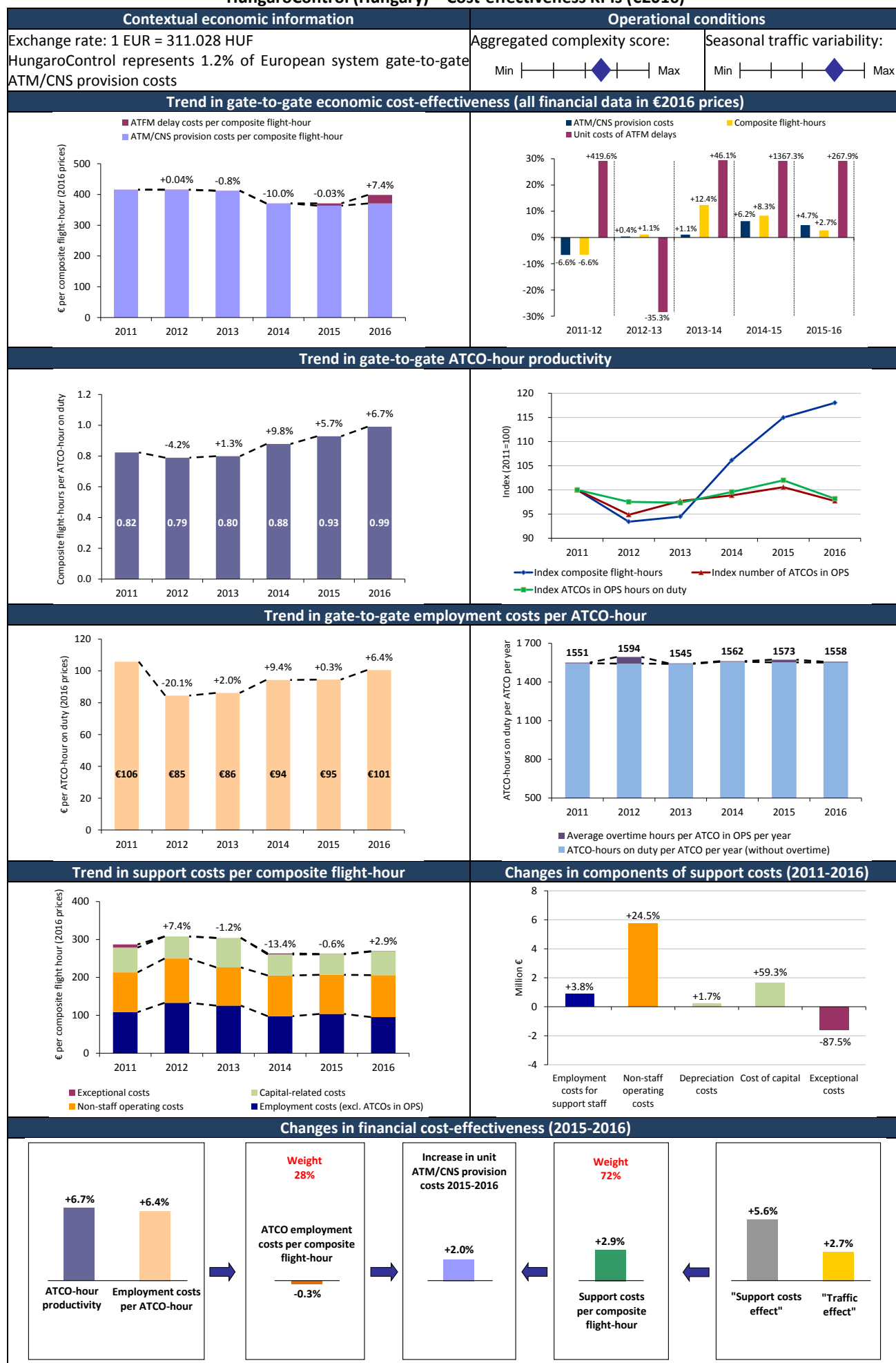
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2000*	C: 2000*	C: 2000*	C: 1998*
€91.8M (2008-2020)	€17.0M	€9.5M	€18.0M			2011				
						2012				
						2013				
						2014				
						2015				
						2016				
						2017				
						2018				
						2019				
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

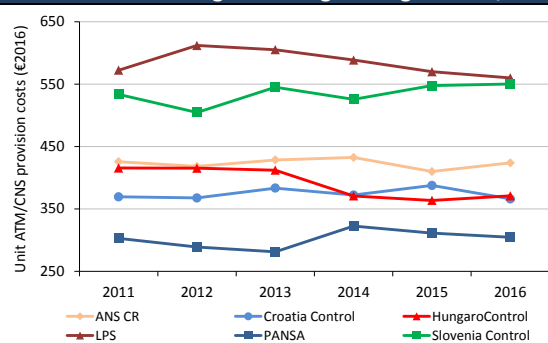
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Procurement installation and commissioning of a new SDPS, FDPS & ODS (PALLAS)	ATM	30.6	2017	2020
2	Replacement of 4 radar (PSR/EMS) systems (Thessaloniki, Iraklion, Rodos and Kerrira Airports)	ATM	15.8	2018	2020
3	Partial replacement of CNS systems at Athina Airport	ATM	9.9	2017	2020
4	Replacement of 8 DVOR, 12 DME and 1 ILS at Greek Airports	NAV	8.9	2017	2019
5	Upgrade of PALLAS system (FDPS, RDPS, ODS, HMI)	ATM	8.1	2015	2018

HungaroControl (Hungary) – Cost-effectiveness KPIs (€2016)

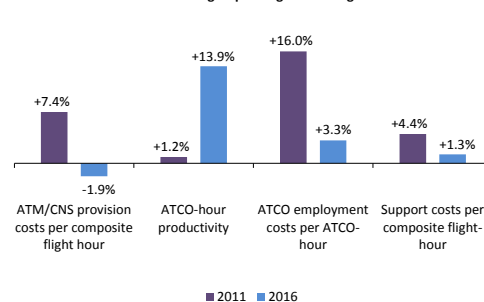


HungaroControl (Hungary) – (€2016)

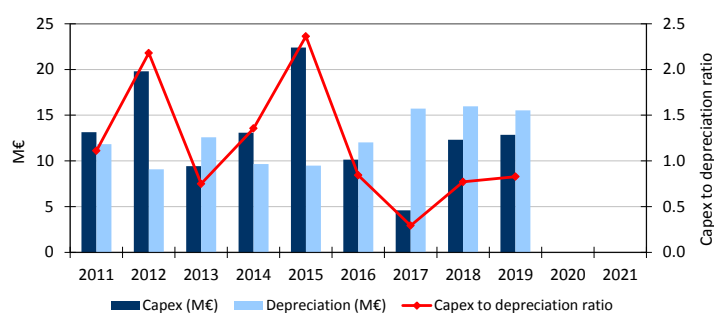
Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Deviation from groups' weighted average



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

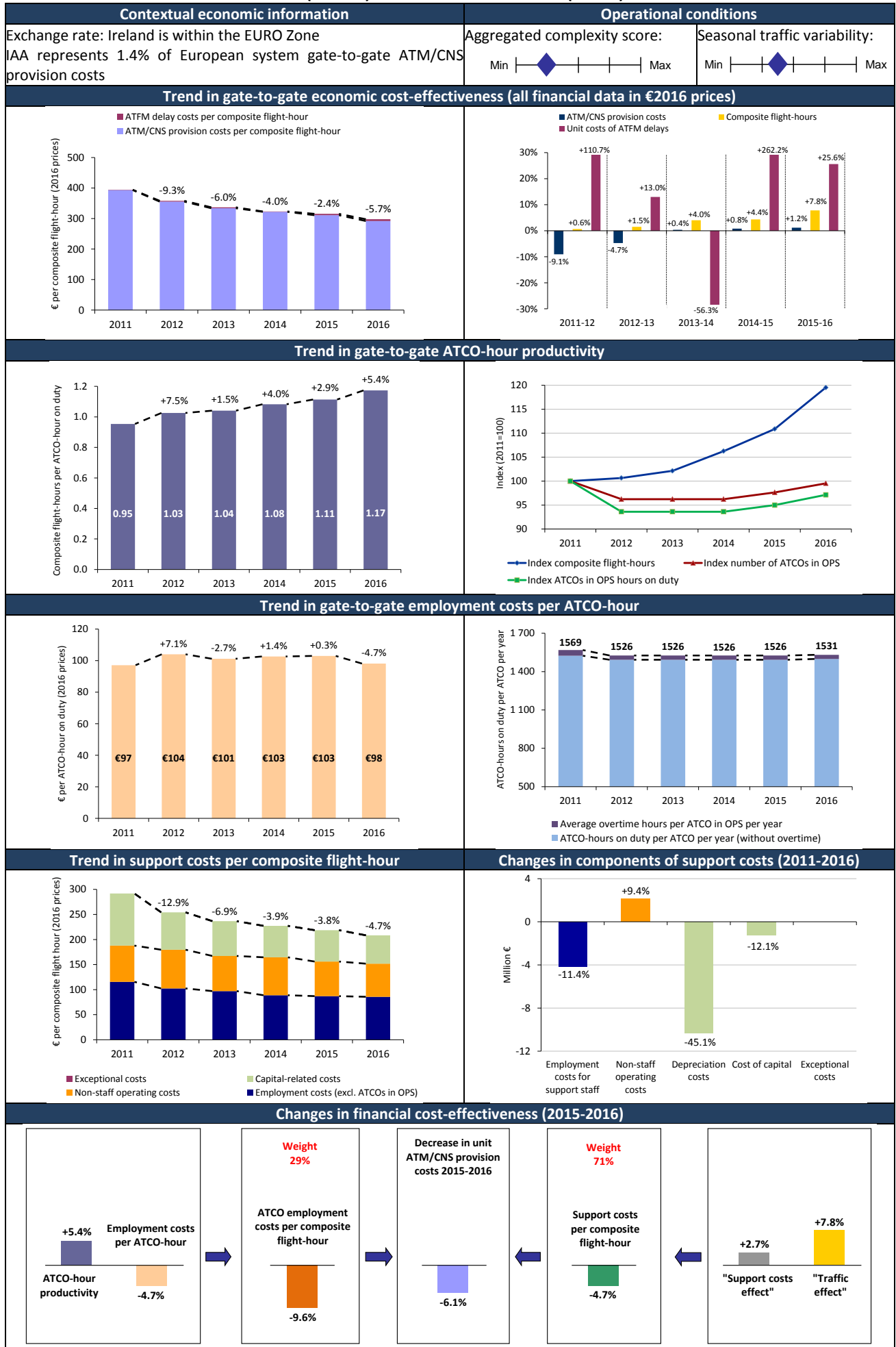
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2012*	C: 2012*	C: 2012*	C: 2012*
€54.0M (2008-2016)	€7.0M (2010-2013)	€1.0M		€14.0M (2010-2012)		2011				
					€0.7M	2012				
						2013				
	€2.0M	€0.9M		€9.4M		2014				
						2015				
			€7.1M		€1.2M	2016				
€28.5M	€1.9M					2017				
						2018				
			€1.5M			2019				
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

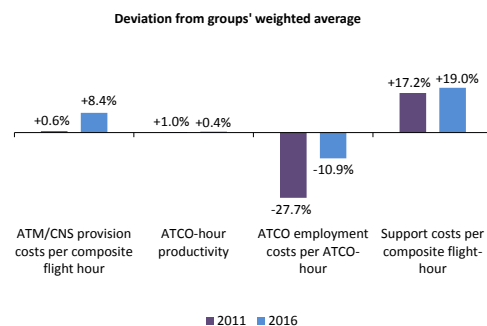
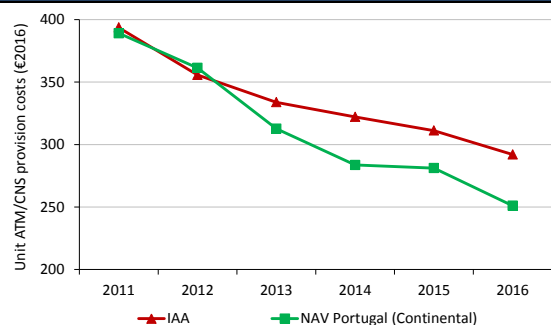
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Matias build 12	ATM	19.0	2018	2019
2	MATIAS SW/HW upgrade (ANS III project)	ATM	19.0	2009	2012
3	ANS III Building (ANS III project)	Buildings	14.0	2010	2012
4	Matias build 11.2	ATM	9.5	2017	2018
5	ANS I (Contingency)	Buildings	9.4	2013	2016

IAA (Ireland) – Cost-effectiveness KPIs (€2016)

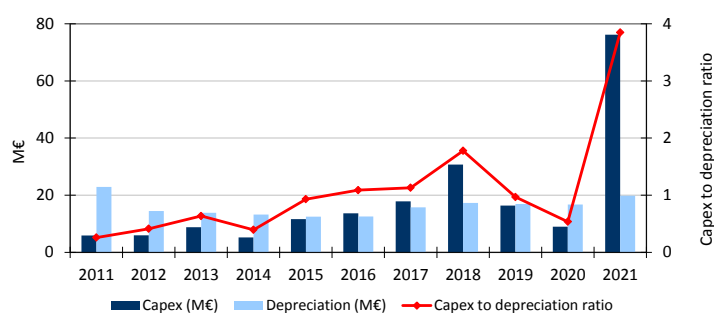


IAA (Ireland) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

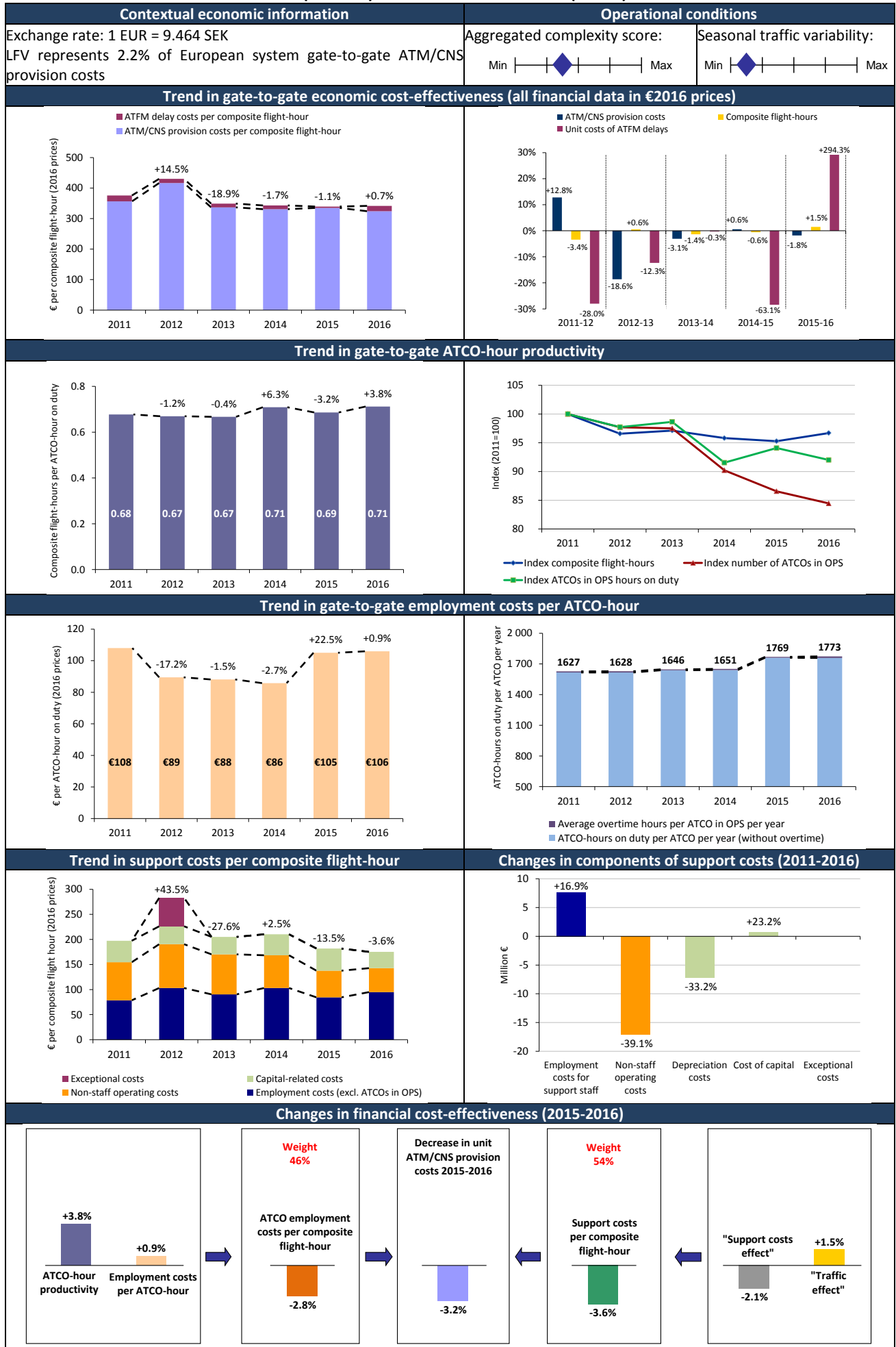
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2011 (All ACCs)*	C: 2014 (All ACCs)*	C: 2011 (All ACCs)*	C: 2015 (All ACCs)*
€164.0M (2006-2021)	€3.6M	€44.6M (2006-2019)			€0.8M	2011	All ACCs		All ACCs	
	€1.2M			€3.7M	2014	All ACCs	All ACCs	All ACCs		
					2015				All ACCs	
					2016	All ACCs	All ACCs	All ACCs		
					2017					
					2018				All ACCs	
			2019							
			2020							
			2021							

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

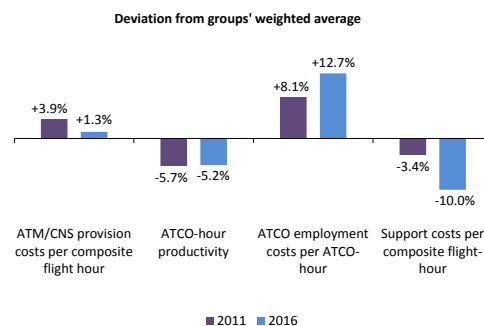
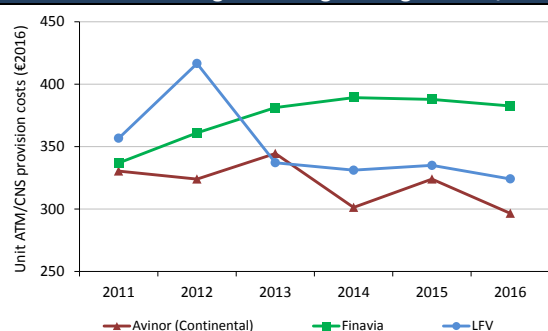
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Dublin Tower	ATM	55.0	2017	2021
2	COOPANS (BUILD 1) initiative, including the replacement of the current FDP and RDP systems	ATM	49.0	2006	2012
3	FDP - COOPANS	ATM	34.5	2015	2019
4	Radar Replacement	SUR	20.0	2006	2011
5	VHFTX/RX & VCS replacement (four locations)	COM	16.9	2015	2019

LFV (Sweden) – Cost-effectiveness KPIs (€2016)

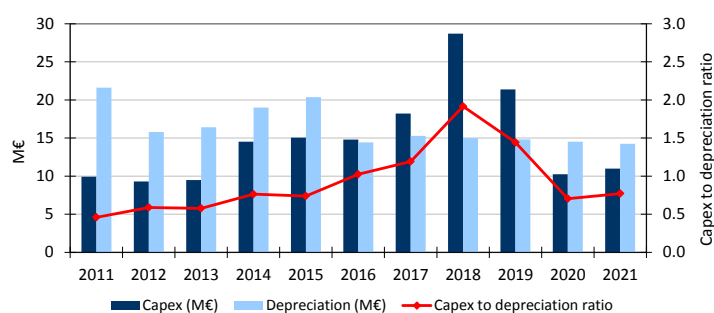


LFV (Sweden) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS C: 2012 (Malmo) 2013 (Stockholm)*	RDP5 C: 2012 (Malmo) 2013 (Stockholm)*	HMI C: 2012 (Malmo) 2013 (Stockholm)*	VCS C: 2010 (All ACCs)*
€132.6M (2006-2020)	€22.0M (2007-2019)		€25.6M	€10.7M (2007-2011)	€17.6M	2011				All ACCs
						2012	Malmo	Malmo	Malmo	
						2013	Stockholm	Stockholm	Stockholm	
						2014				
						2015			All ACCs	
						2016	All ACCs			
						2017		All ACCs		
						2018	All ACCs	All ACCs		All ACCs
						2019				
						2020			All ACCs	
						2021				

* C = Commissioning

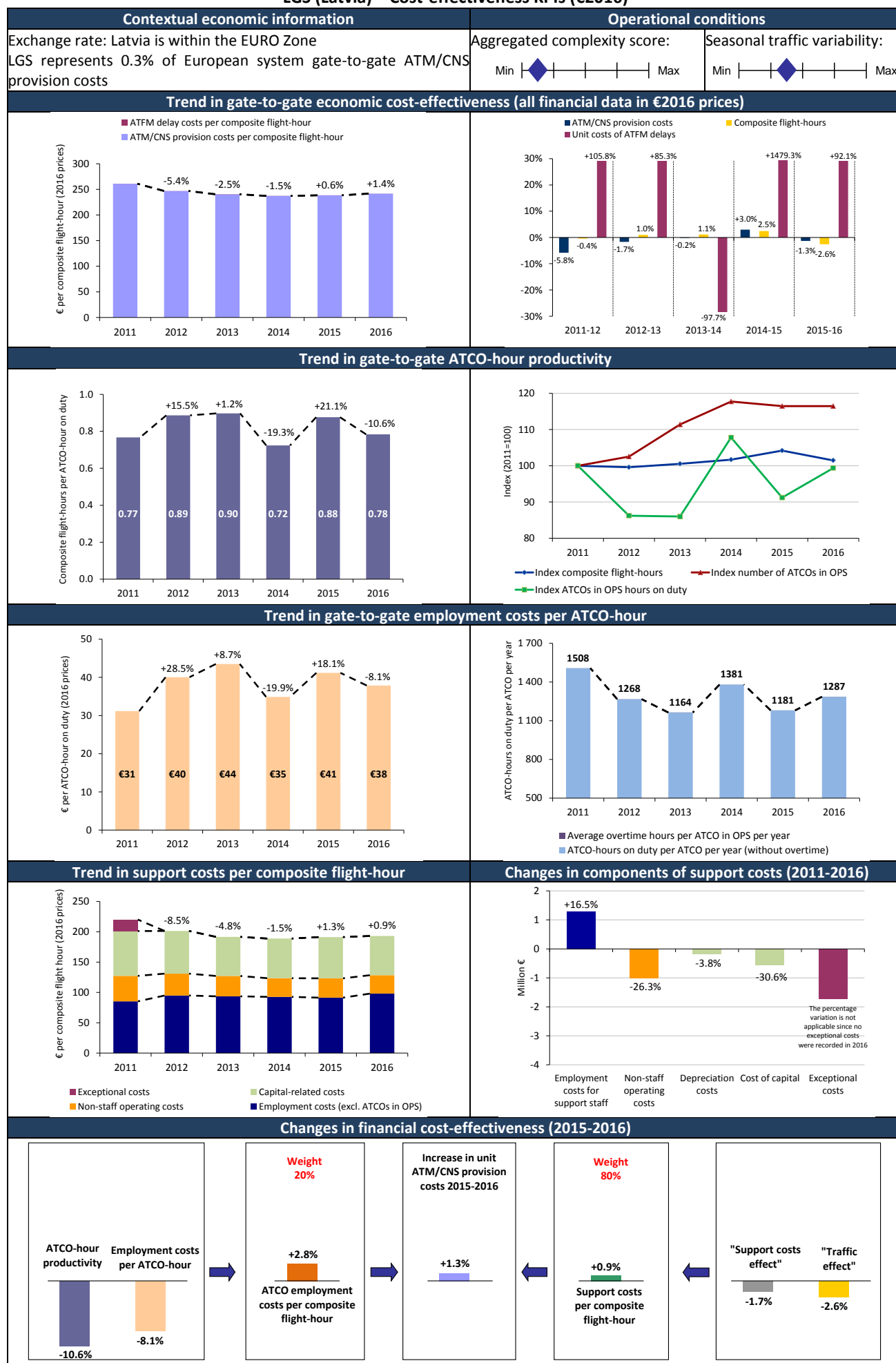
Upgrade

Replacement

Focus on the top five capex projects

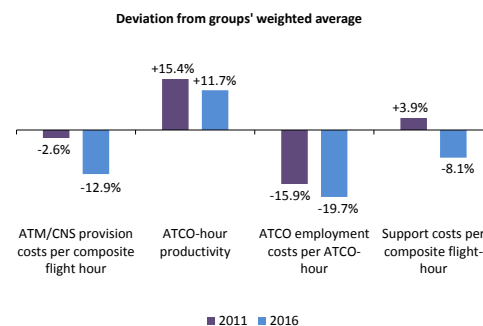
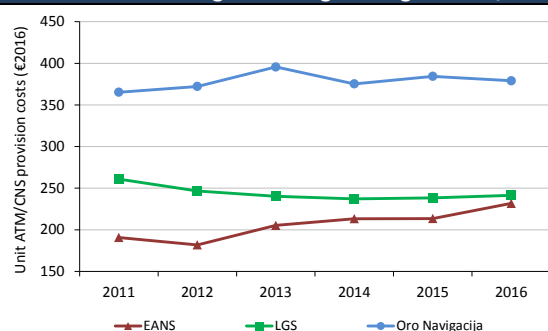
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	COOPANS	ATM	81.1	2006	2020
2	Expansion of Remote Tower Service	ATM	22.9	2017	2020
3	PCP investments	Other	15.3	2018	2021
4	Remote Tower Centre (RTC)	ATM	13.3	2010	2018
5	Contingency system	ATM	12.8	2016	2020

LGS (Latvia) – Cost-effectiveness KPIs (€2016)

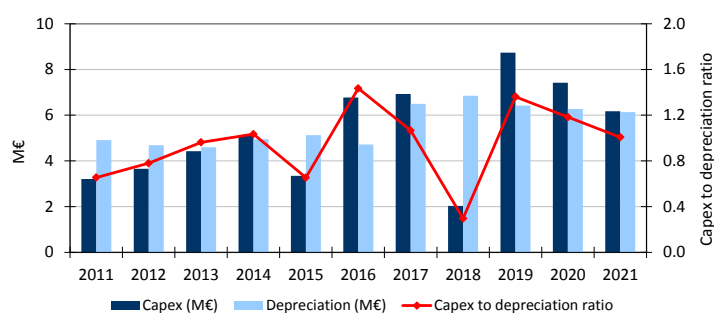


LGS (Latvia) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

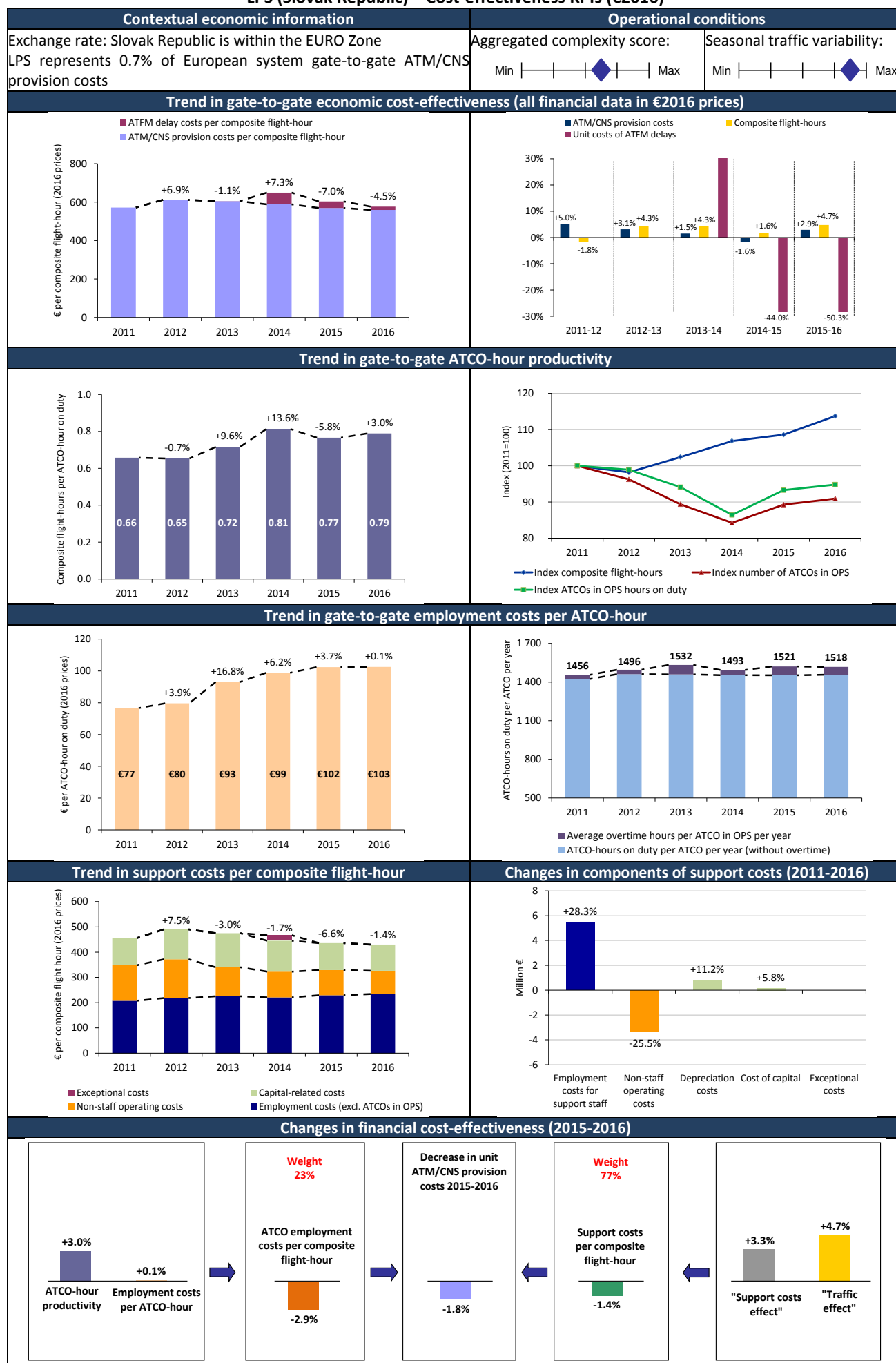
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 1999*	C: 1999*	C: 1999*	C: 2004*
€28.0M (2010-2024)	€2.1M		€1.7M (2007-2012)		€4.6M	2011				
						2012				
						2013				
	€4.9M		€1.2M			2014				
						2015				
						2016				
						2017				
			€8.8M			2018				
						2019				
				€14.1M (2018-2024)		2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

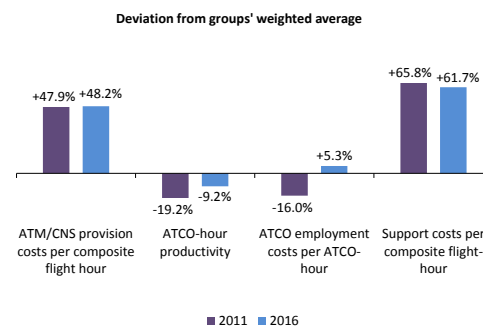
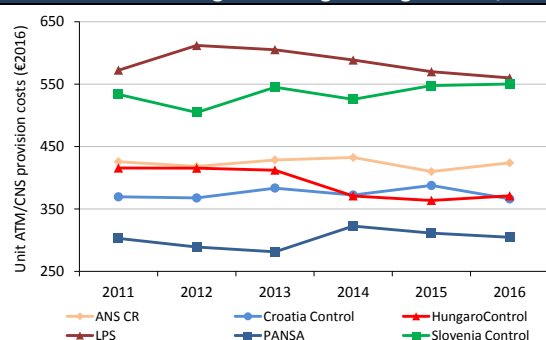
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Construction of new Tech building & TWR (incl. Modernization)	Buildings	14.1	2018	2024
2	A-SMGCS Modernisation - Part II	SUR	8.8	2015	2019
3	PBN Implementation project	ATM	6.8	2015	2019
4	Modernization of Automated ATC system (ATRACC)	ATM	3.9	2010	2013
5	Air Traffic Control System ATRACC extension	ATM	3.5	2014	2016

LPS (Slovak Republic) – Cost-effectiveness KPIs (€2016)

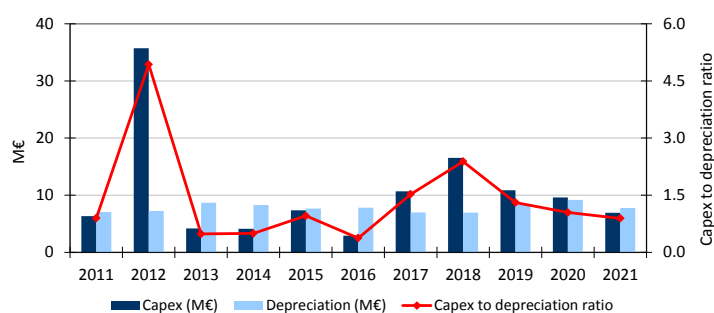


LPS (Slovak Republic) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



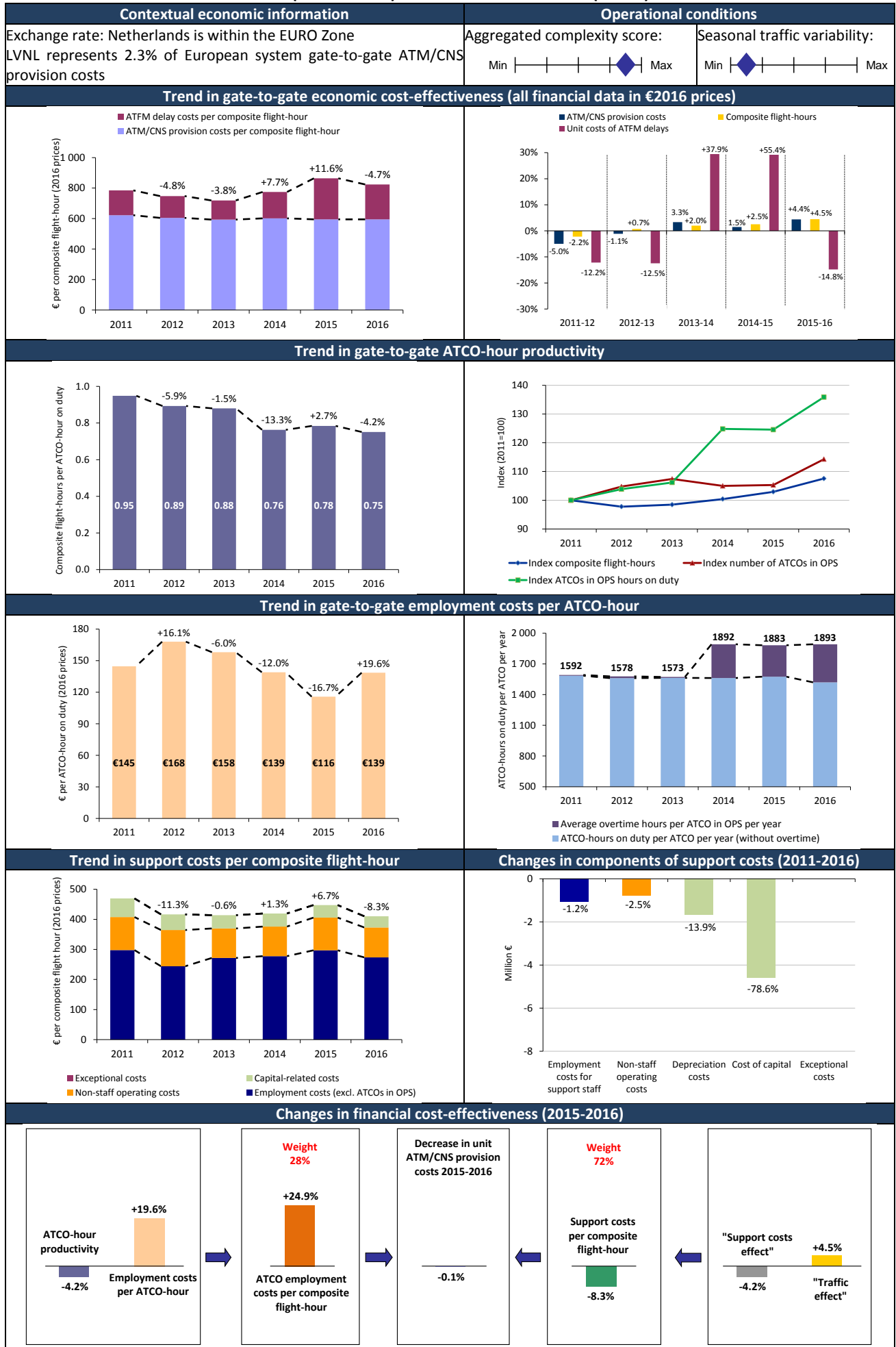
Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Building	Other	Years	FDPS C: 1999*	RDPS C: 2005*	HMI C: 1999*	VCS C: 2009*
€30.0M (2010-2020)	€14.5M	€14.5M (2014-2025)	€6.0M (2009-2018)	€33.5M (2007-2015)	€15.3M	2011				
						2012				
						2013				
						2014				
						2015				
						2016				
						2017				
						2018				
						2019				
						2020				
						2021				

Focus on the top five capex projects

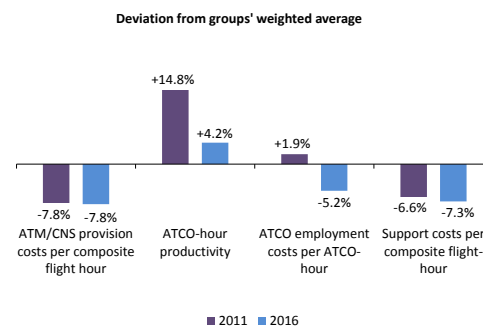
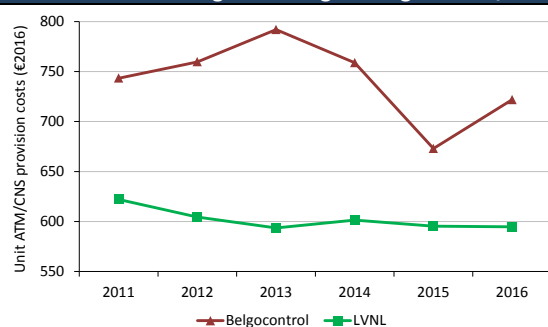
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Construction of the new ACC in Bratislava	Buildings	30.0	2007	2012
2	Upgrade of the main ATM System	ATM	20.4	2015	2020
3	Navigation Systems Upgrade	NAV	14.1	2017	2025
4	Replacement of SACON Network	COM	5.0	2015	2019
5	Upgrade of Voice Communication System - Implementation of VoIP	COM	4.5	2017	2019

LVNL (Netherlands) – Cost-effectiveness KPIs (€2016)

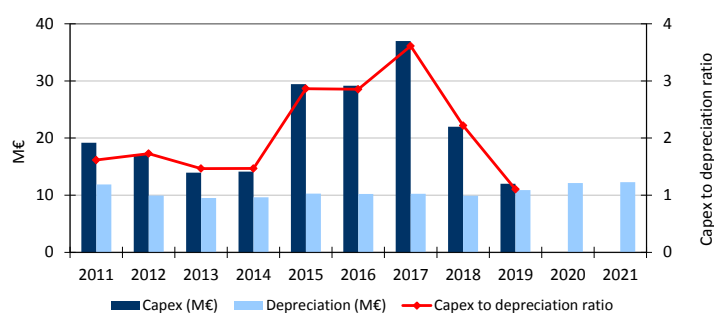


LVNL (Netherlands) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

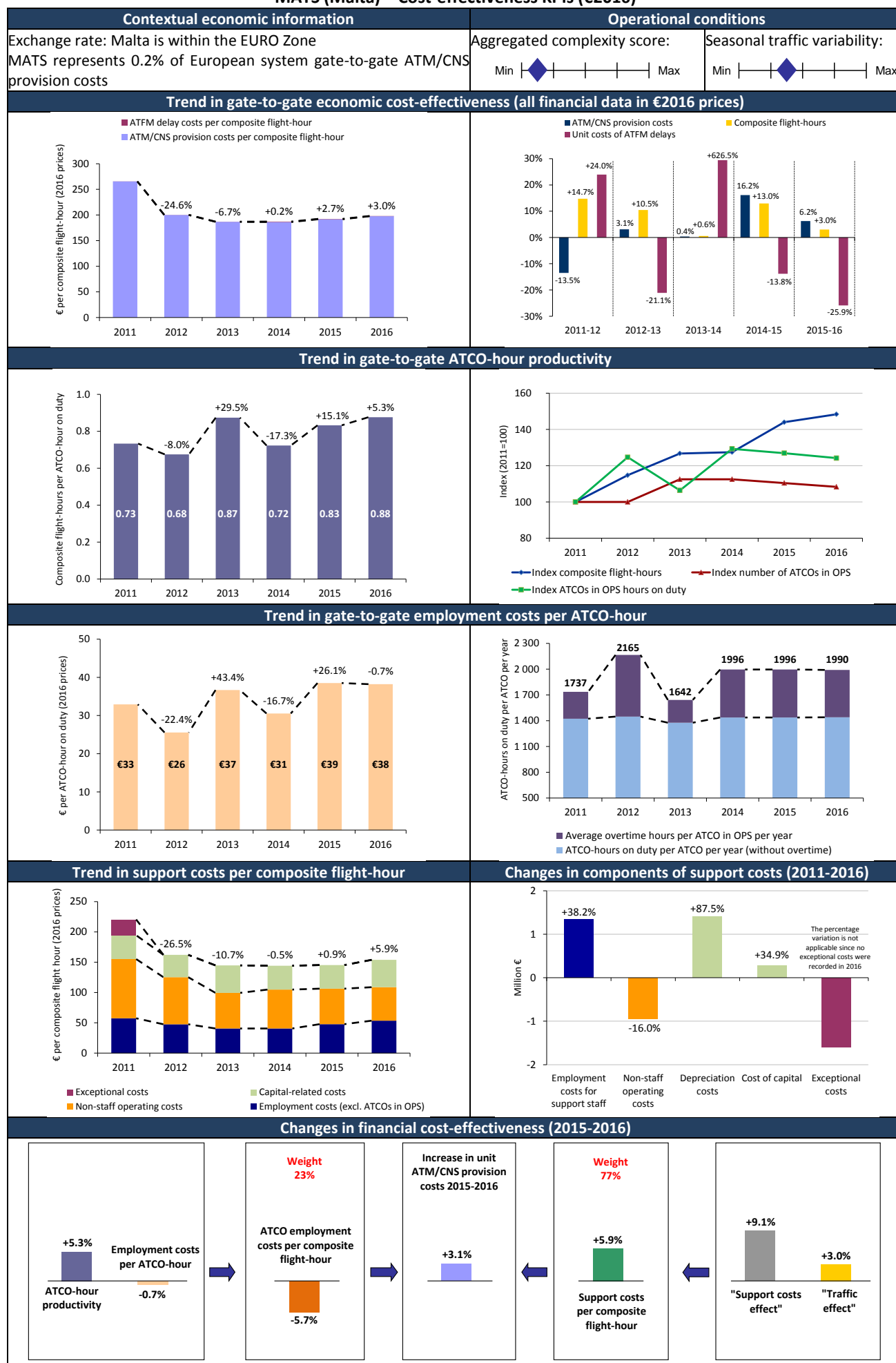
ATM	COM	NAV	SUR	Building	Other	Years	FDPS	RDPS	HMI	VCS
							C: 1998*	C: 1998*	C: 1998*	C: 2015*
€105.0M (2009-2022)	€30.8M (2007-2016)		€14.8M	€8.0M (2010-2012)	€3.5M (2010-2012)	2011				
						2012				
						2013				
						2014				
						2015				
						2016				
				€21.5M	€41.3M	2017				
						2018				
						2019				
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

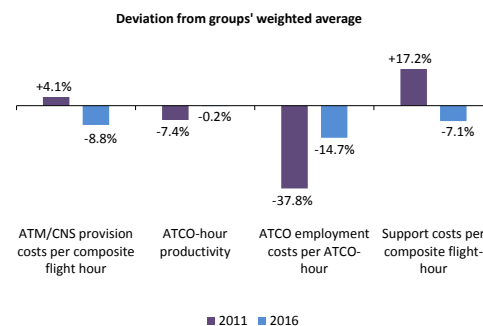
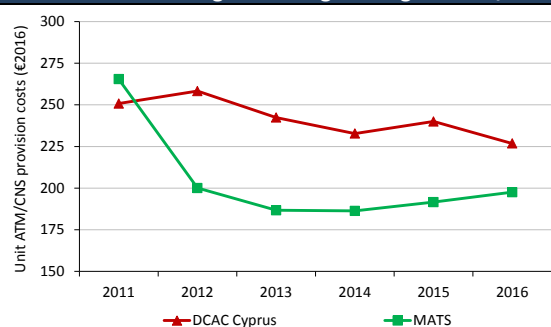
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	New ATM system ICAS (iTEC Centre Automation System)	ATM	78.0	2011	2022
2	Replacement of VCS	COM	24.6	2007	2015
3	Expansion Facilities	Buildings	21.5	2016	2019
4	Maintenance investments (systems and infrastructure)	Other	14.2	2015	2019
5	Replacement TAR IV (Terminal Approach Radar)	SUR	9.7	2015	2017

MATS (Malta) – Cost-effectiveness KPIs (€2016)

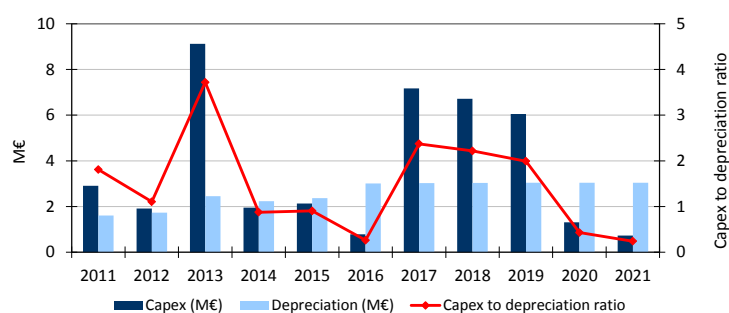


MATS (Malta) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

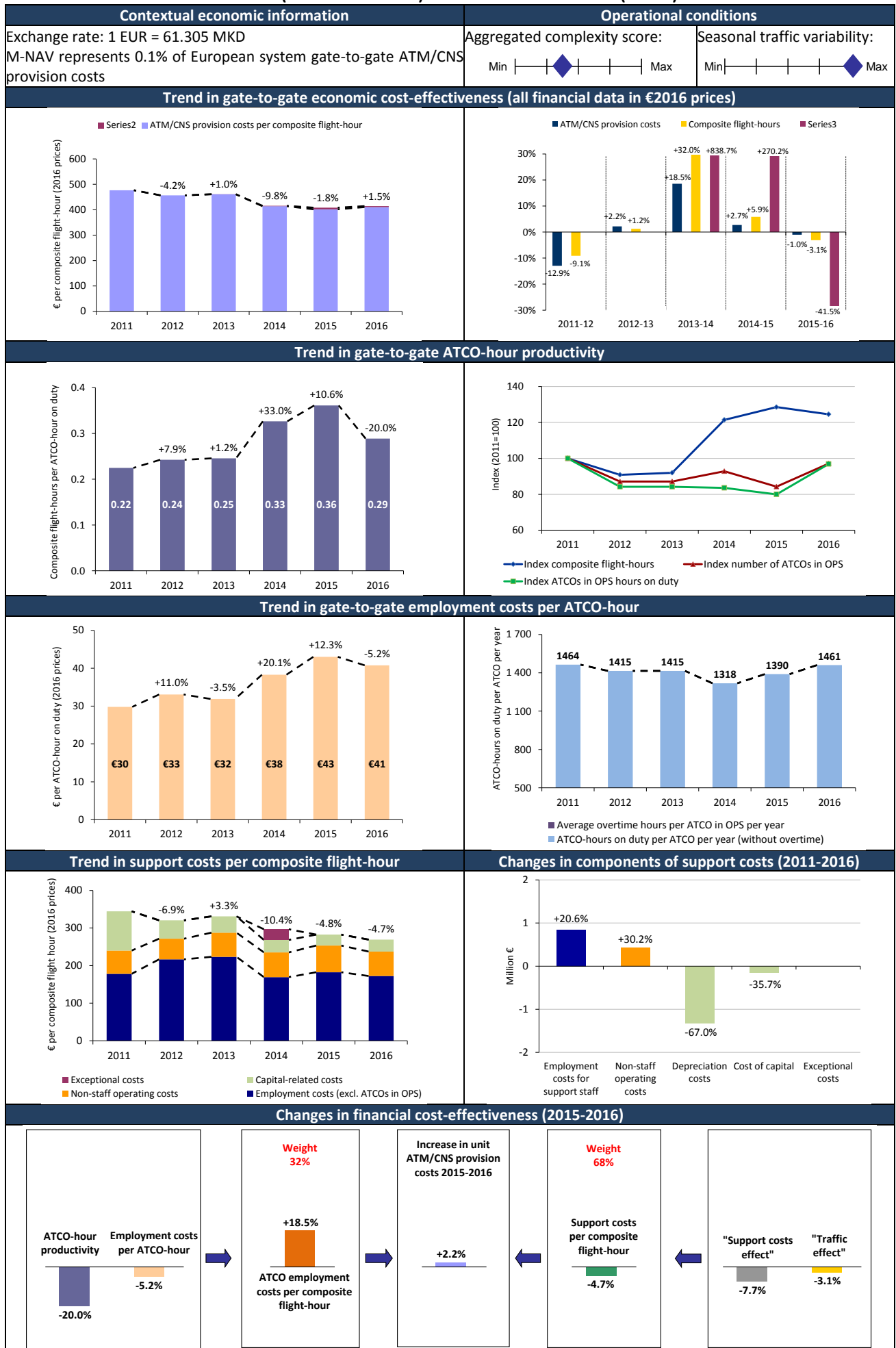
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 1996*	C: 1996*	C: 1996*	C: 2015*
€9.0M			€2.4M (2009-2013)	€1.9M (2010-2015)		2011				
						2012				
						2013				
			€2.4M			2014				
	€0.5M	€0.2M				2015				
					€0.3M	2016				
		€0.8M	€3.7M	€18.1M		2017				
						2018				
						2019				
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

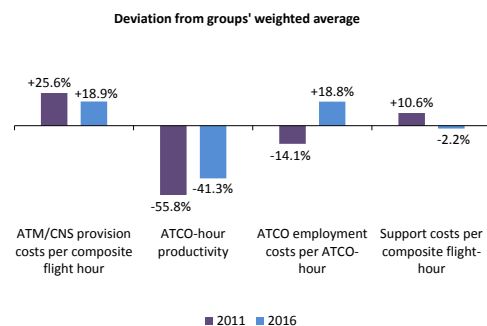
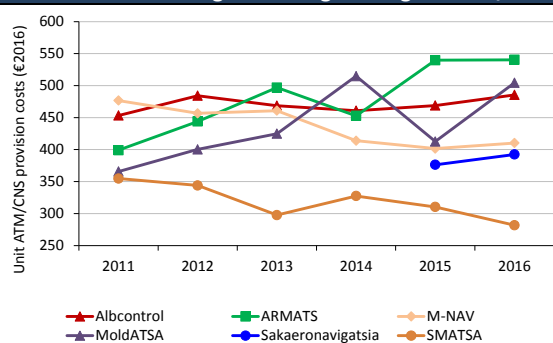
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	New control centre and tower	Buildings	18.0	2017	2019
2	Enhancements and variations to new ATM system	ATM	9.0	2012	2017
3	Dingli En-Route Primary Surveillance Radar & Weather Channel	SUR	2.9	2016	2018
4	Purchase and installation of MSSR Halfar	SUR	2.4	2009	2013
5	Purchase and installation of MSSR Fawwara	SUR	2.4	2014	2015

M-NAV (F.Y.R. Macedonia) – Cost-effectiveness KPIs (€2016)

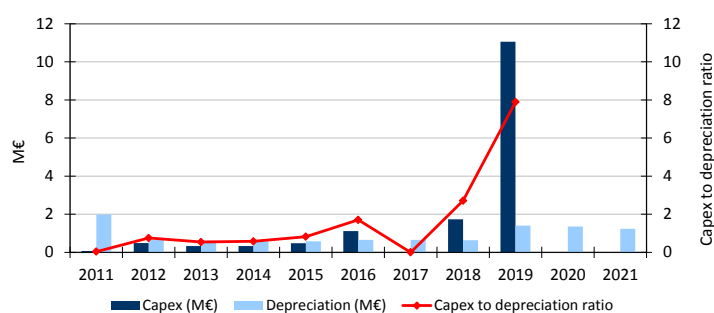


M-NAV (F.Y.R. Macedonia) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2002*	C: 2002*	C: 2002*	C: 2002*
						2011				
						2012				
€0.3M						2013				
						2014				
	€1.7M		€3.2M	€1.0M	€0.8M**	2015				
€7.9M						2016				
						2017				
						2018				
						2019				
						2020				
						2021				

**This amount includes €0.8M related to MET

* C = Commissioning

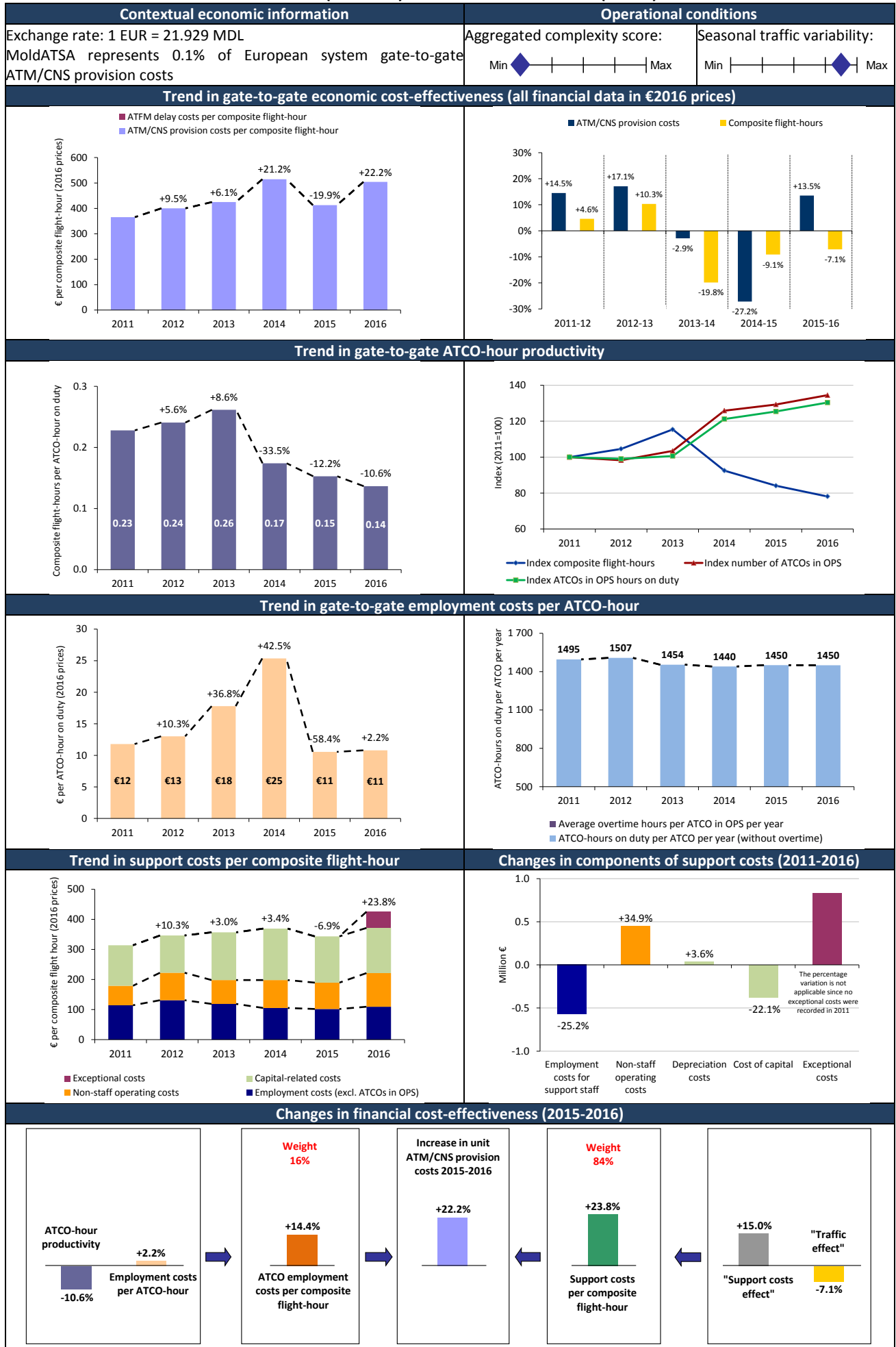
Upgrade

Replacement

Focus on the top five capex projects

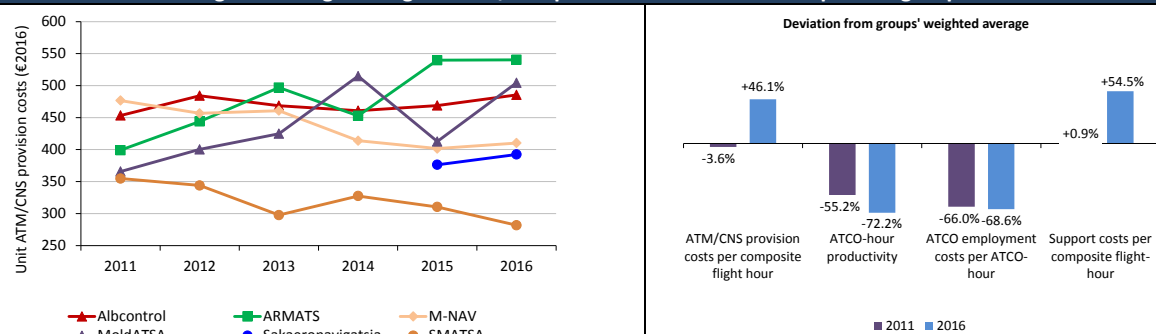
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Procurement of new ATM systems	ATM	7.9	2015	2019
2	New Mode S radar at Skopje	SUR	2.4	2015	2019
3	Construction of new building for ANSP headquarters	Buildings	1.0	2013	2017
4	Purchase of new VHF radio system and MW link	COM	0.8	2015	2018
5	Replacement of AWOS/VOLMET/ATIS equipment at Skopje and Ohrid airports	Other	0.8	2015	2017

MoldATSA (Moldova) – Cost-effectiveness KPIs (€2016)

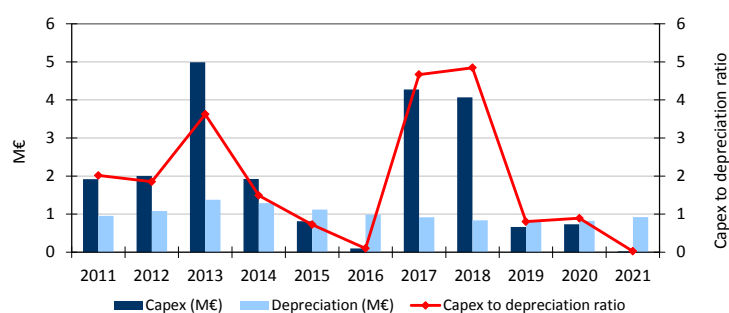


MoldATSA (Moldova) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2013*	C: 2013*	C: 2013*	C: 2013*
						2011				
						2012				
						2013				
						2014				
			€3.1M			2015				
						2016				
€0.9M						2017				
		€1.9M		€3.8M	€0.7M	2018				
						2019				
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Construction and modernisation of the tower building in Chisinau	Buildings	3.8	2018	2020
2	Implementation of multilateration equipment	SUR	2.3	2014	2015
3	Modernisation of system ILS26/08	NAV	1.5	2019	2020
4	Simulation Facilities for air traffic control training (including TWR 3D Simulator + VCS)	ATM	0.9	2017	2018
5	MLAT system	SUR	0.7	2014	2016

MUAC (Maastricht) – Cost-effectiveness KPIs (€2016)

Contextual economic information

Exchange rate: Maastricht is within the EURO Zone
MUAC represents 1.8% of European system gate-to-gate ATM/CNS provision costs

Operational conditions

Aggregated complexity score:
Seasonal traffic variability:

Trend in gate-to-gate economic cost-effectiveness (all financial data in €2016 prices)

ATM delay costs per composite flight-hour

ATM/CNS provision costs per composite flight-hour

Year	ATM delay costs	ATM/CNS provision costs	% Change
2011	250	250	
2012	265	265	+6.6%
2013	250	250	-3.8%
2014	280	280	+13.7%
2015	300	230	+9.1%
2016	400	230	+30.2%

ATM/CNS provision costs

Composite flight-hours

Unit costs of ATM delays

Period	ATM/CNS provision costs	Composite flight-hours	Unit costs of ATM delays
2011-12	+6.4%	-0.7%	-5.5%
2012-13	-5.3%	+2.6%	+93.0%
2013-14	+5.6%	+2.2%	+135.0%
2014-15	-7.0%	+2.3%	+103.7%
2015-16	+5.7%	+4.1%	+96.9%

Trend in gate-to-gate ATCO-hour productivity

Composite flight-hours per ATCO-hour on duty

Year	Value	% Change
2011	1.95	
2012	1.94	-0.4%
2013	1.99	+2.5%
2014	1.96	-1.6%
2015	1.97	+0.4%
2016	2.03	+3.0%

Index composite flight-hours

Index number of ATCOs in OPS

Index ATCOs in OPS hours on duty

Year	Index composite flight-hours	Index number of ATCOs in OPS	Index ATCOs in OPS hours on duty
2011	100	100	100
2012	99	103	99
2013	102	106	100
2014	105	112	104
2015	107	110	106
2016	111	111	107

Trend in gate-to-gate employment costs per ATCO-hour

€ per ATCO-hour on duty (2016 prices)

Year	Value	% Change
2011	167	
2012	203	+21.9%
2013	203	+0.1%
2014	215	+5.8%
2015	211	-2.0%
2016	216	+2.5%

ATCO-hours on duty per ATCO per year

Year	Value
2011	1205
2012	1168
2013	1133
2014	1119
2015	1153
2016	1157

Trend in support costs per composite flight-hour

€ per composite flight-hour (2016 prices)

Year	Exceptional costs	Non-staff operating costs	Employment costs (excl. ATCOs in OPS)	Capital-related costs	% Change
2011	20	20	110	10	
2012	20	20	110	10	-1.1%
2013	20	20	100	10	-11.4%
2014	20	20	110	10	+0.3%
2015	20	20	90	10	-14.4%
2016	20	20	100	10	+3.2%

Changes in components of support costs (2011-2016)

Component	% Change
Employment costs for support staff	-17.0%
Non-staff operating costs	+16.8%
Depreciation costs	-26.6%
Cost of capital	-71.9%
Exceptional costs	

Changes in financial cost-effectiveness (2015-2016)

ATCO-hour productivity

Employment costs per ATCO-hour

Category	2015	2016
ATCO-hour productivity	+3.0%	+3.0%
Employment costs per ATCO-hour	+2.5%	+2.5%

ATCO employment costs per composite flight-hour

Year	Value
2015	-0.5%
2016	-0.5%

Support costs per composite flight-hour

Year	Value
2015	+3.2%
2016	+3.2%

"Support costs effect"

"Traffic effect"

Category	2015	2016
"Support costs effect"	+7.5%	+7.5%
"Traffic effect"	+4.1%	+4.1%

Weight 47%

Weight 53%

Increase in unit ATM/CNS provision costs 2015-2016

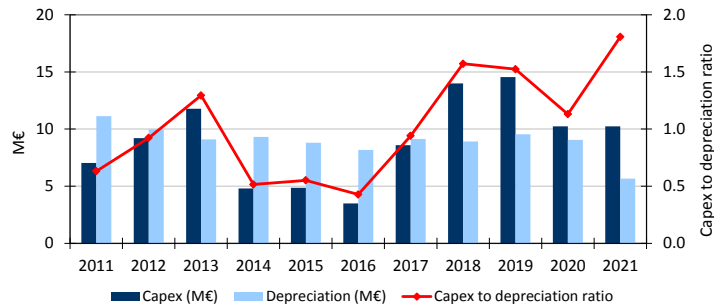
Year	Value
2015	+1.5%
2016	+1.5%

MUAC (Maastricht) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group

Due to the unique nature of its airspace (upper airspace only, across four States), it was decided that Maastricht (MUAC) should be considered separately and therefore this ANSP is not included in the comparator group benchmarking analysis

Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

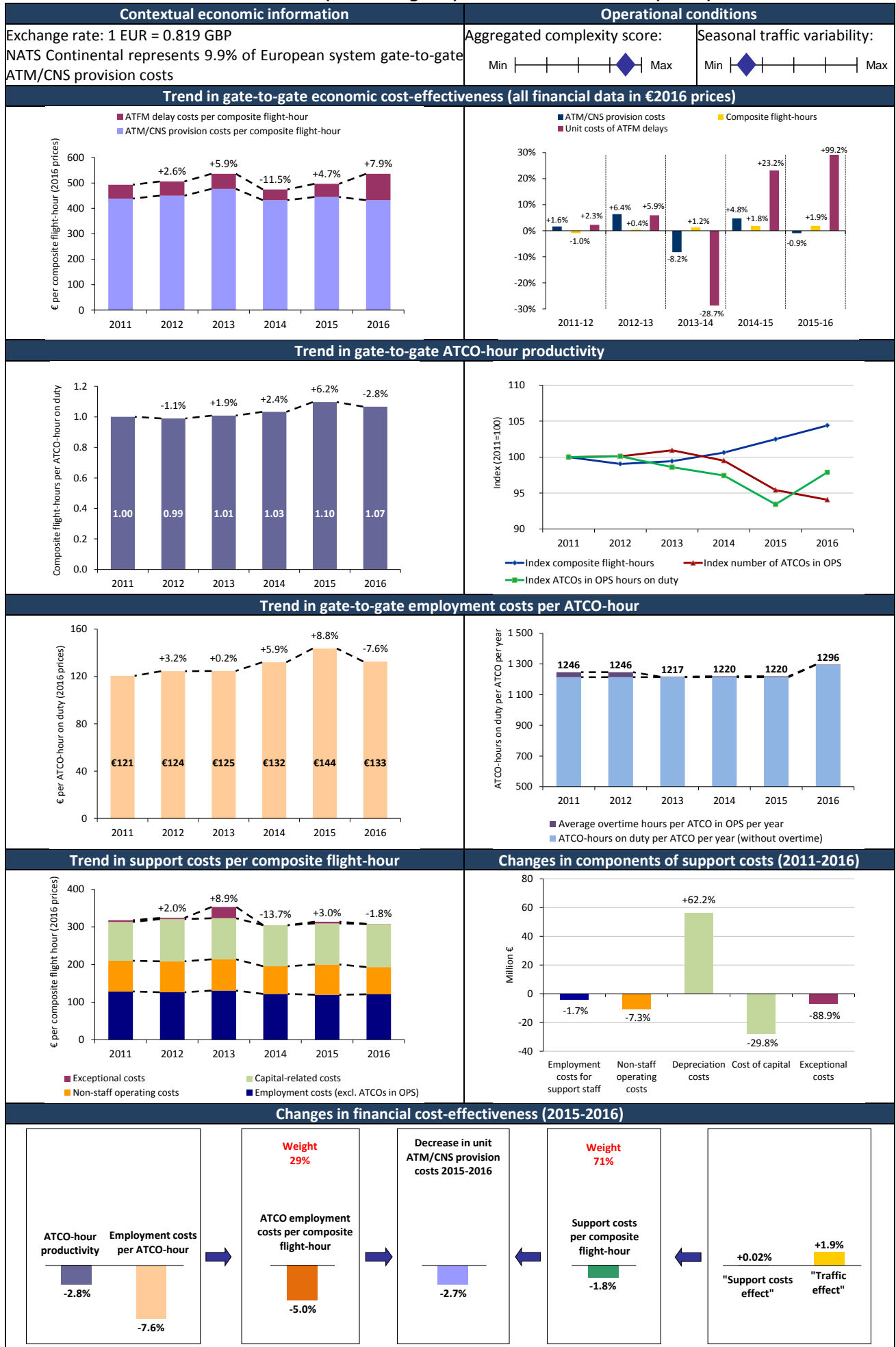
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDP5	HMI	VCS
							C: 2008*	C: 2008*	C: 2002*	C: 1995*
€55.6M (2003-2014)	€5.1M					2011				
						2012				
				€14.6M	€4.7M	2013				
						2014				
€49.8M	€8.6M					2015				
						2016				
						2017				
				€13.1M	€13.8M	2018				
						2019				
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

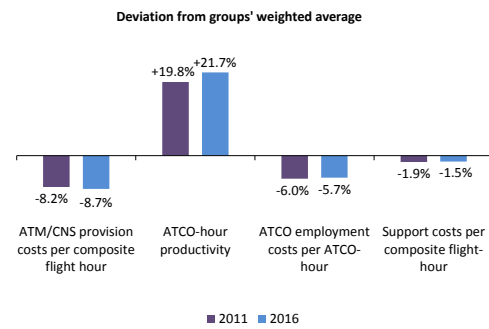
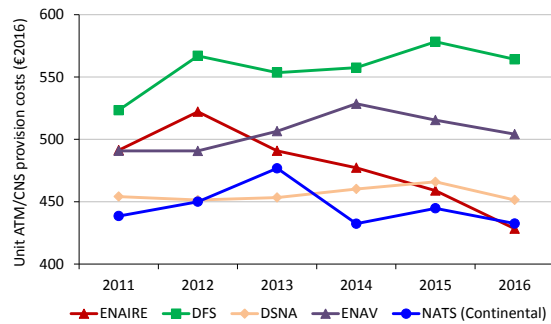
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Procurement of new FDPS	ATM	50.0	2003	2011
2	Other ATM investments	ATM	27.9	2015	2021
3	Building and infrastructure (RP1)	Buildings	14.6	2012	2014
4	ATM SESAR Compliant (RP3)	ATM	9.0	2020	2021
5	Building and infrastructure (RP2)	Buildings	7.7	2015	2019

NATS Continental (United Kingdom) – Cost-effectiveness KPIs (€2016)



NATS Continental (United Kingdom) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs

Note that the planned data provided by NATS in its 2016 ACE submission reflect the figures reported in the Performance Plan for RP2, which are based on regulatory accounting rules. This is different from the methodology used by NATS to report historic and actual figures which are based on IFRS accounting.

Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS C: 2002 (Lon. AC) 2001 (Lon. TC and Prestwick**)*	RDPS C: 2010 (Lon. AC) 2007 (Lon. TC) 2009 (Prestwick)*	HMI C: 2009 (Lon. AC and Prestwick**) 2007 (Lon. TC)*	VCS C: 2002 (Lon. AC) 2007 (Lon. TC) 2008 (Prestwick)*
€228.3M (2003-2011)				€18.7M (2008-2011)		2011	London AC and London TC		London AC	London TC
€314.9M	€82.3M				€68.9M	2012				
						2013				
						2014				
€528.6M	€135.9M				€78.5M	2015		London TC+Prestwick	London AC (2016)+Prestwick (2015-2017)	London TC+Prestwick
						2016	London AC+TC Prestwick	London AC		
						2017	Prestwick	London AC		
						2018				
						2019			London TC+Prestwick	London AC
						2020	London AC (2020-2023)	London AC+TC+Prestwick	London AC	London TC+Prestwick
						2021				

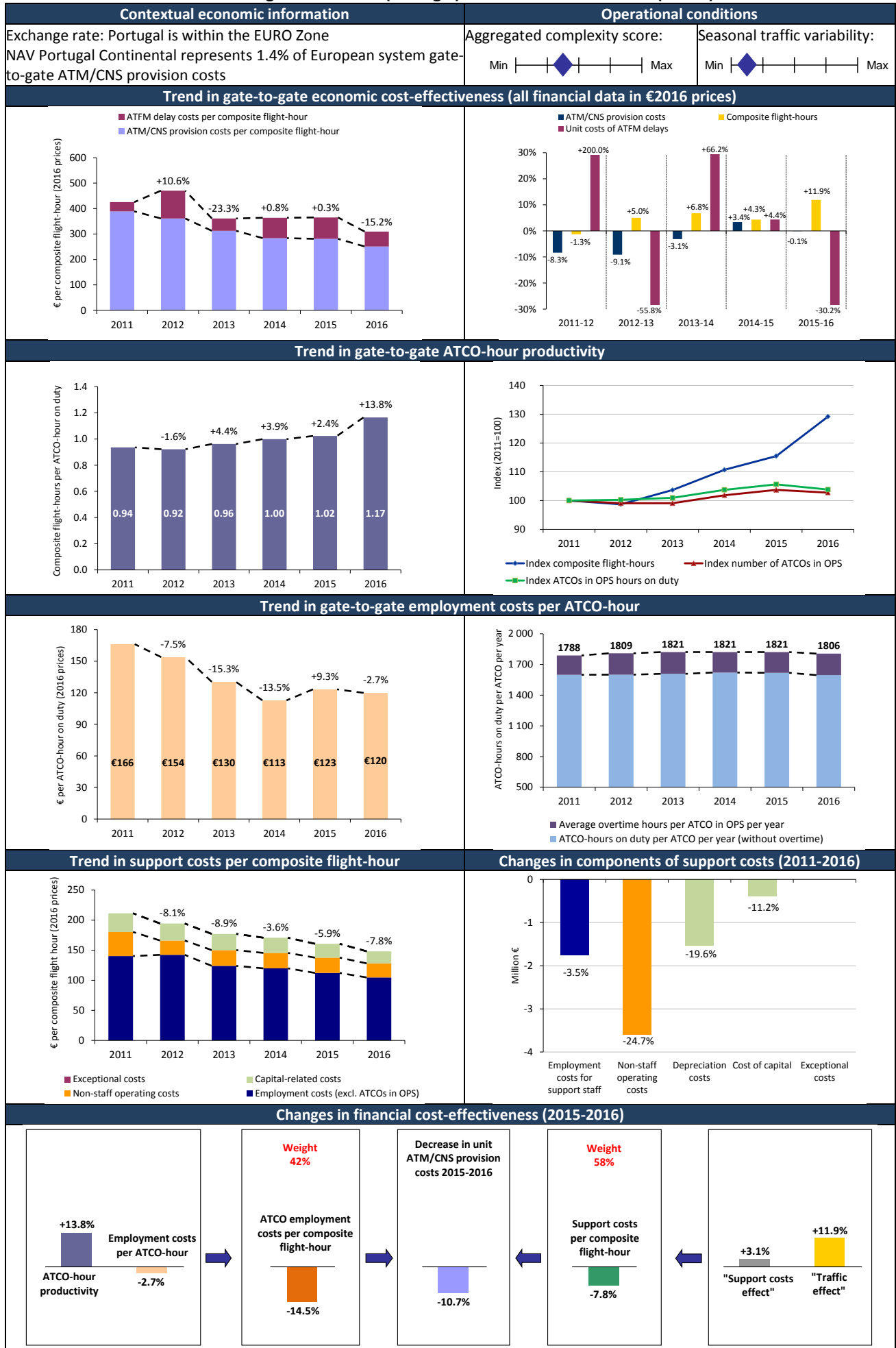
* C = Commissioning Upgrade Replacement

** The information reported in the right-hand side of the chart for Prestwick ACC refers to the systems used for the upper (based on ITEC from 2016 onwards) and lower (NAS & NODE) airspace.

Focus on the top five capex projects

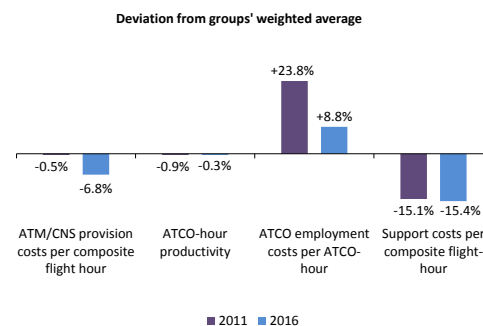
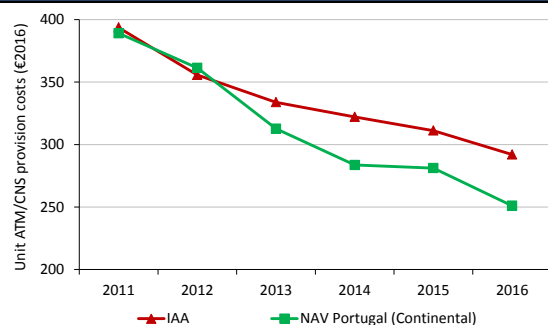
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	iTEC (including Prestwick Upper Airspace Definition)	ATM	388.5	2012	2019
2	Centre Systems Software Development (including NAS Version NA37.01)	ATM	355.1	2012	2019
3	CNS Infrastructure (including NERC N38 System Ethernet and MSRS Change, Da Vinci Network Enhancement)	CNS	218.2	2012	2019
4	iFACTS	ATM	198.2	2003	2011
5	Airspace Development (including Time Base Separation)	ATM	37.4	2015	2019

NAV Portugal Continental (Portugal) – Cost-effectiveness KPIs (€2016)

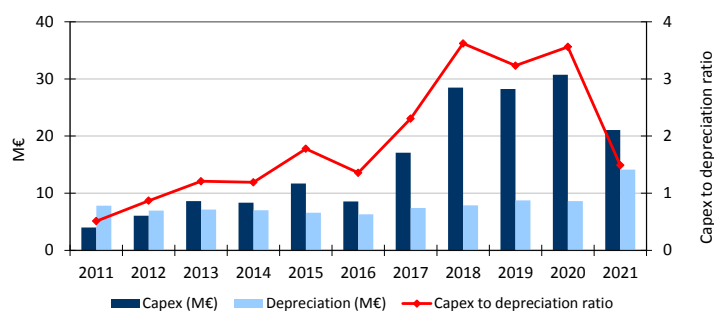


NAV Portugal Continental (Portugal) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2001*	C: 2001*	C: 2001*	C: 1999*
						2011				
						2012				
€5.1M	€2.9M	€1.1M	€1.7M	€3.7M	€3.1M	2013				
						2014				
						2015				
						2016				
€15.2M	€4.8M	€9.3M	€8.9M	€3.8M	€5.2M	2017				
						2018				
						2019				
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

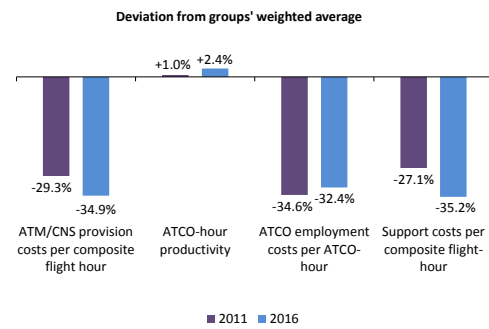
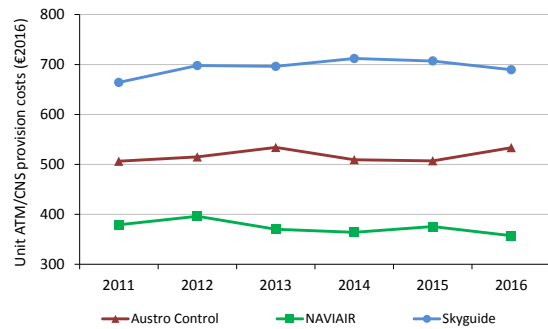
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	ATM systems program (mainly including the evolution of the LISATM system into LISATM-FDPS)	ATM	20.3	2012	2019
2	Surveillance program (mainly including equipment for Lisbon FIR, Mode S radar sensors, replacement of Lisbon radar)	SUR	10.6	2012	2019
3	Nav aids program (mainly including new ILS systems at Porto and Lisbon and the installation of nav aids in the Porto TMA)	NAV	10.4	2012	2019
4	Communication program (mainly including new VCS system and purchase of tape recorders and communications systems in the Lisbon FIR)	COM	7.7	2012	2019
5	Building program (mainly including facilities maintenance in Lisbon)	Buildings	7.5	2012	2019

NAVIAIR (Denmark) – Cost-effectiveness KPIs (€2016)

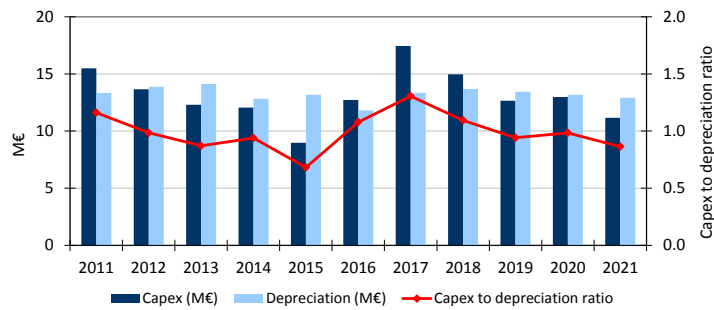


NAVIAIR (Denmark) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

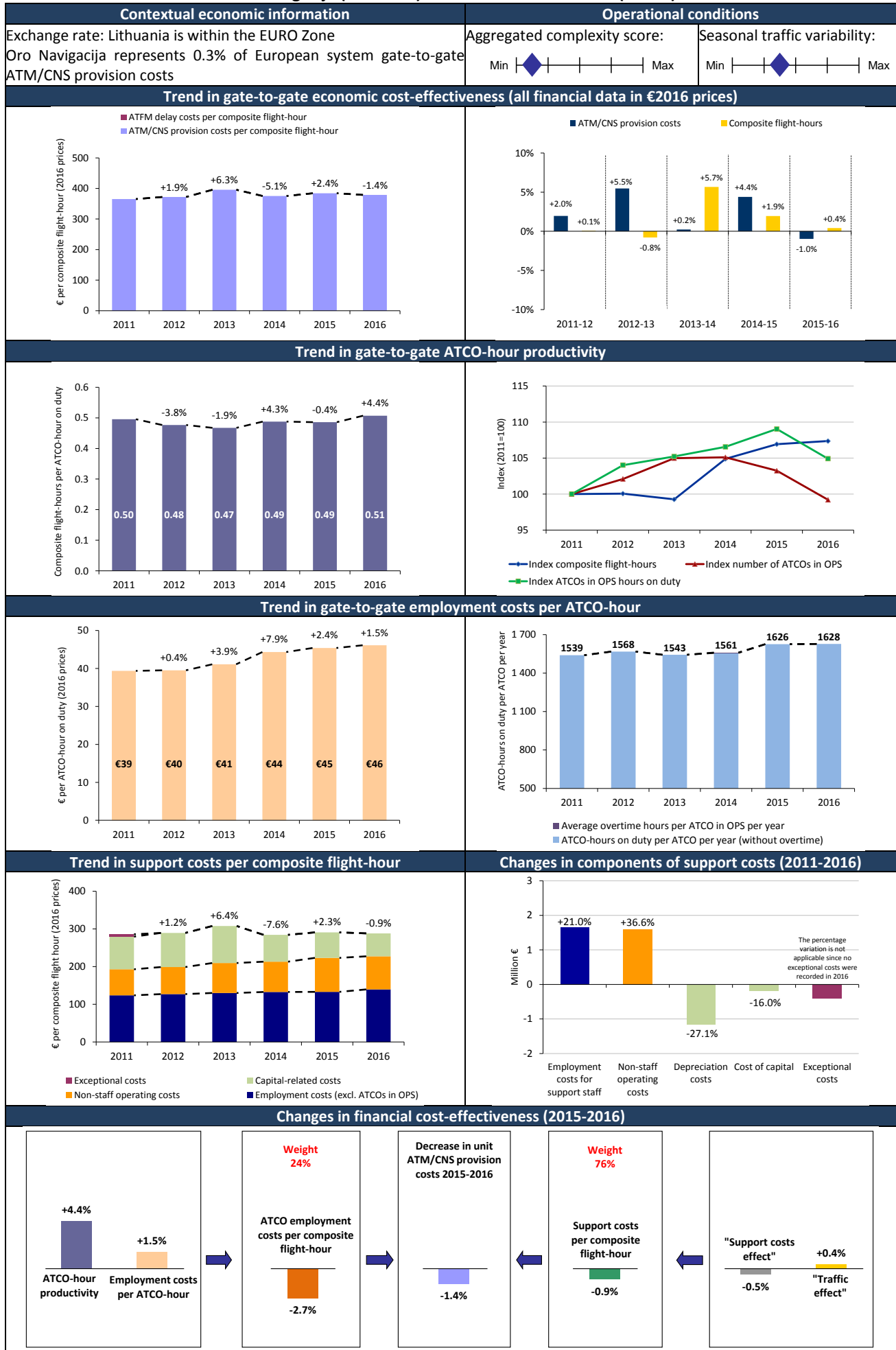
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2012*	C: 2006*	C: 2012*	C: 2007*
						2011	Continuous upgrades of the FDP and RDP systems as part of the COOPANS Alliance and for the ARTAS RDP system			
						2012				
						2013				
						2014				
						2015				
						2016				
						2017				
						2018				
						2019				
						2020				
€21.3M	€7.2M	€0.4M	€11.3M	€11.5M	€2.9M	2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

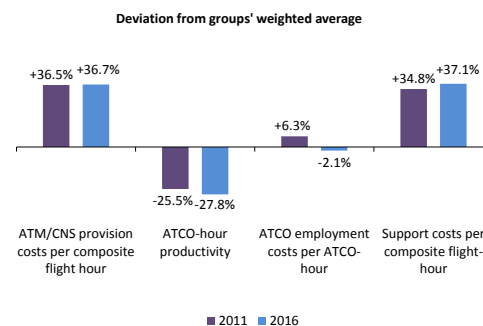
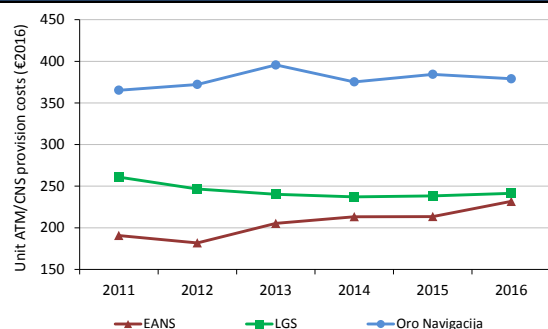
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Investments mainly relating to COOPANS and the upgrade of the FDP, RDP and HMI systems	ATM	21.3	2017	2021
2a	Investments mainly relating to the implementation of Voice over Internet Protocol (VoIP) programme and related projects	COM	18.9	2017	2021
2b		NAV			
2c		SUR			
3	Investments mainly related to buildings	Buildings	14.4	2017	2021
4	Other	Other			

Oro Navigacija (Lithuania) – Cost-effectiveness KPIs (€2016)

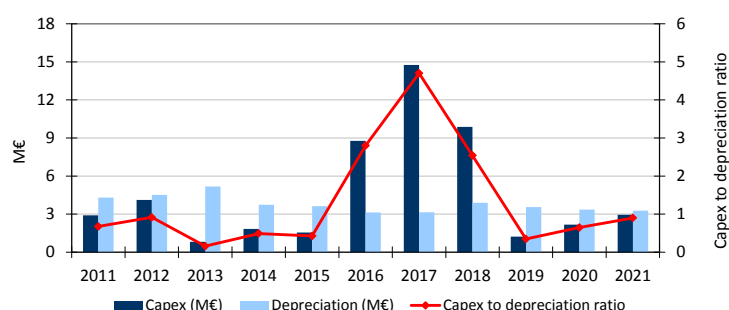


Oro Navigacija (Lithuania) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

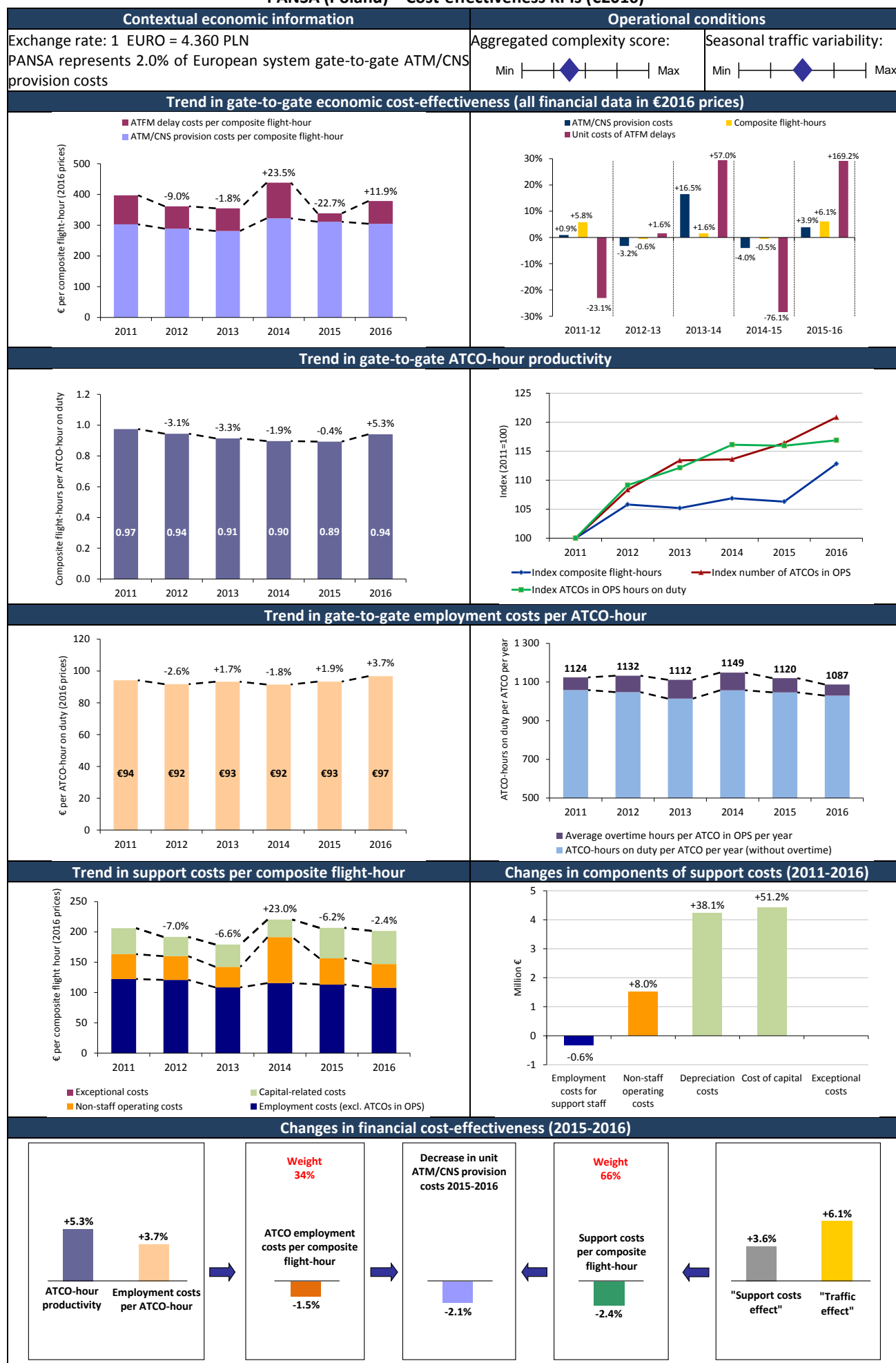
ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2005*	C: 2005*	C: 2005*	C: 2005*
€5.1M (2008-2014)	€3.0M (2009-2013)	€1.7M				2011				
						2012				
						2013				
						2014				
€16.7M	€2.3M	€0.8M		€12.2M	€1.9M	2015				
						2016				
						2017				
						2018				
						2019				
						2020				
						2021				
		€1.7M								

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

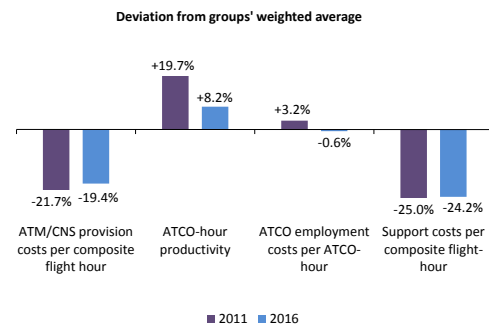
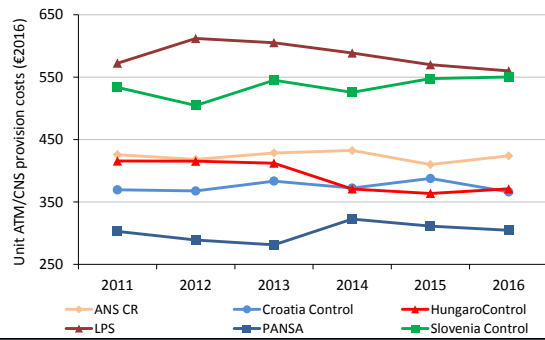
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Installation of the new ATC system in new ACC	ATM	13.6	2015	2019
2	ACC and Administration building	Buildings	12.2	2014	2018
3	ATCC equipment modernisation (Vilnius) (ICAO FPL2012 model implementation; Automated Assistance to Controller for Seamless Coordination, Transfer and Dialogue; Safety Nets Level II; and others)	ATM	3.7	2008	2014
4	Improvement of the transmission network	COM	3.0	2009	2013
5	Modernization of A-SMGCS in Vilnius	ATM	2.6	2015	2018

PANSA (Poland) – Cost-effectiveness KPIs (€2016)

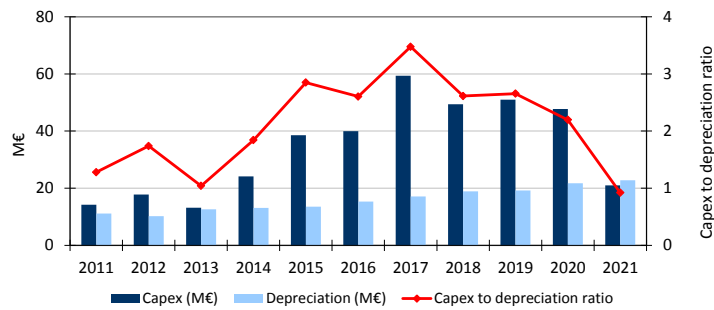


PANSA (Poland) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2013*	C: 2013*	C: 2013*	C: 2013*
€28.0M (2008-2014)		€23.3M (2010-2020)			€4.4M (2010-2011)	2011				
	18.7M		€12.2M			2012				
						2013				
						2014				
€41.8M			€36.2M	€30.8M	2015					
					2016					
					2017					
					2018					
	2019									

* C = Commissioning

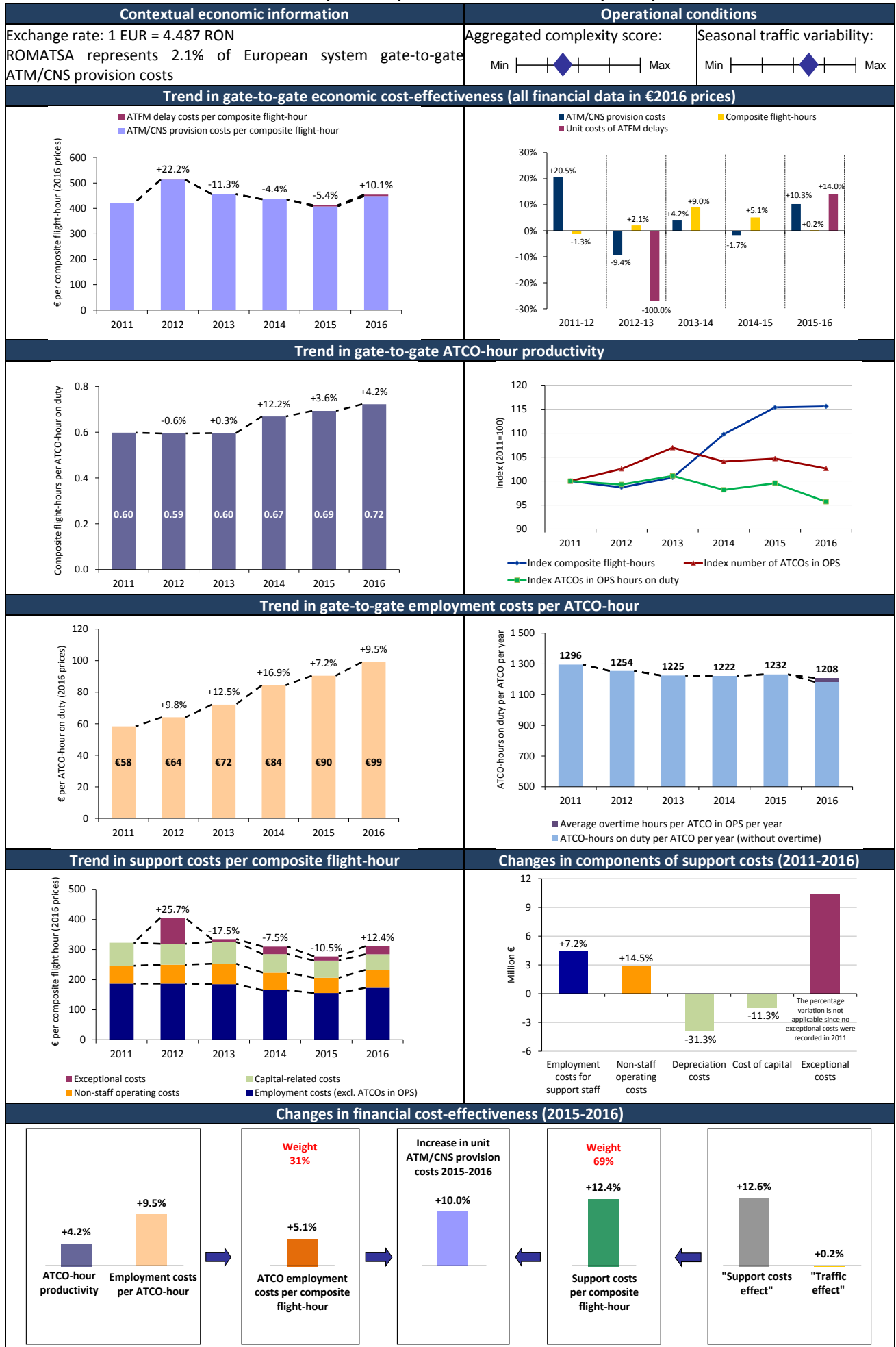
Upgrade

Replacement

Focus on the top five capex projects

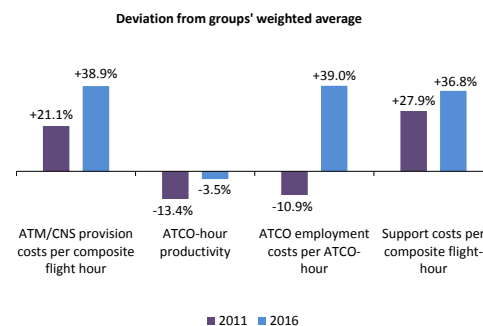
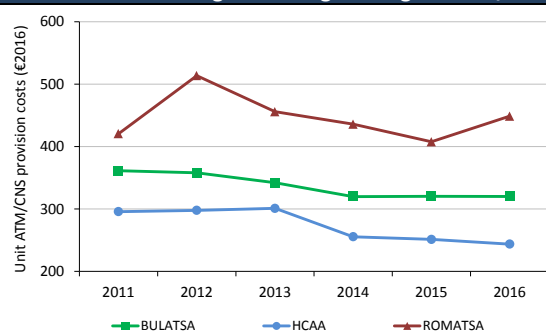
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	ATC training and contingency infrastructure	ATM	71.4	2015	2023
2	Towers (Katowice, Kraków, Poznań) & other	Buildings	36.2	2015	2019
3	Pegasus ATM system and supporting systems	ATM	30.8	2015	2020
4	Radio location system	SUR	28.8	2015	2020
5	Implementation of PEGASUS ATM system	ATM	25.6	2008	2014

ROMATSA (Romania) – Cost-effectiveness KPIs (€2016)

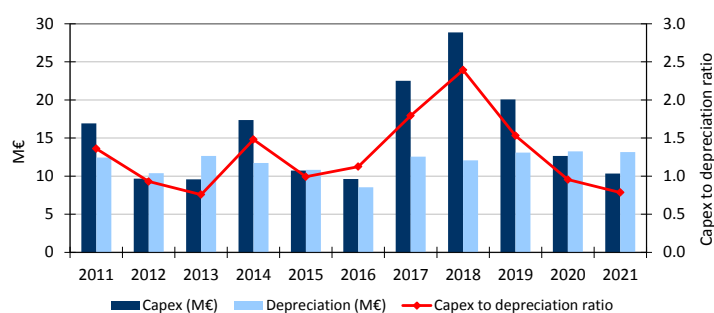


ROMATSA (Romania) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2003*	C: 2003*	C: 2003*	C: 2014*
€58.0M (2008-2025)	€7.4M (2010-2016)	€1.1M (2009-2013)	€21.4M (2009-2020)		€10.4M	2011				
						2012				
						2013				
				2014						
	€2.1M	€5.4M		2015						
				2016						
				2017						
				2018						
				2019						
				2020						

* C = Commissioning

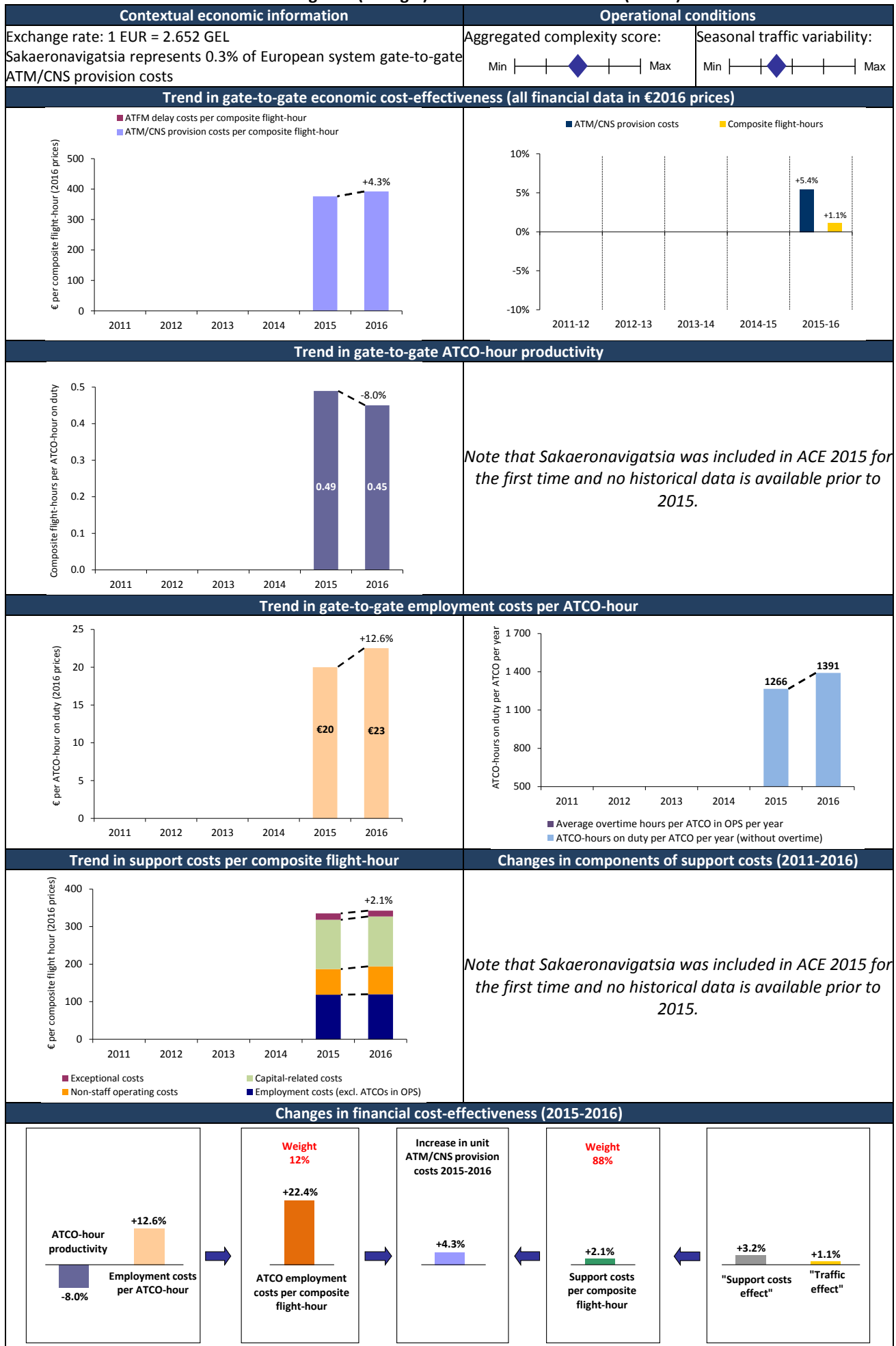
Upgrade

Replacement

Focus on the top five capex projects

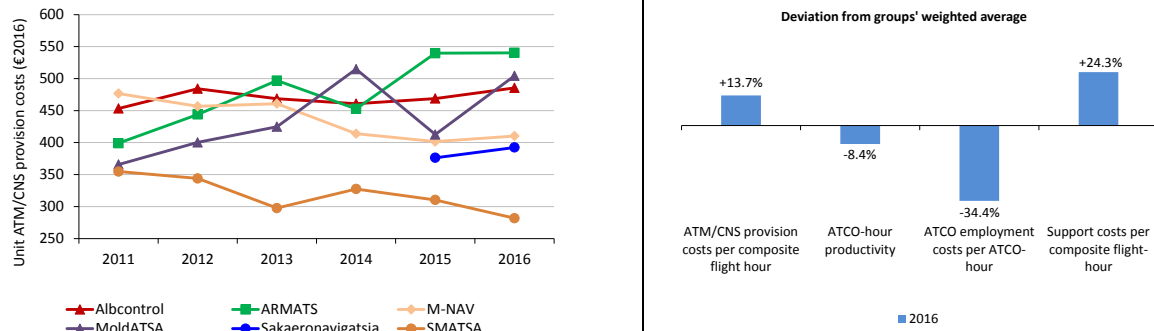
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	ATM System ROMATSA 2015+ Phase I	ATM	30.4	2013	2019
2	ATM System ROMATSA 2015+ Phase II	ATM	14.9	2019	2021
3	ATM System ROMATSA 2015+ Phase III	ATM	9.9	2021	2025
4	New Cluj tower	Buildings	7.9	2014	2017
5	VCSS Systems (CNS 03 - 10-13)	COM	4.9	2012	2016

Sakaeronavigatsia (Georgia) – Cost-effectiveness KPIs (€2016)

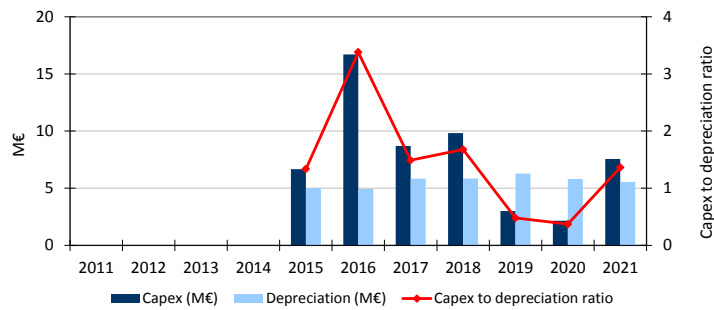


Sakaeronavigatsia (Georgia) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2009*	C: 2009*	C: 2009*	C: 2009*
						2011				
						2012				
						2013				
€9.5M	€1.4M	€0.8M		€2.3M	€7.9M**	2014				
						2015				
	€2.0M	€1.1M	€3.2M			2016				
						2017				
						2018				
						2019				
				€3.4M (2019-2022)		2020				
						2021				

** Includes capex for equipment/system upgrades linked to the provision of MET services

* C = Commissioning

Upgrade

Replacement

Focus on the top five capex projects

Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	New ATC system in Tbilisi Airport and backup at Kutaisi Airport	ATM	6.0	2015	2018
2	Rehabilitation of Runway in Tbilisi Airport	Other	3.7	2015	2016
3	Construction of Training Building	Buildings	3.4	2019	2022
4	ADS-B/MLAT/WAM	SUR	2.6	2017	2021
5	Tbilisi ATC building construction	Buildings	2.3	2014	2017

Contextual economic information

Exchange rate: 1 EUR = 1.090 CHF
Skyguide represents 3.9% of European system gate-to-gate
ATM/CNS provision costs

Operational conditions

Aggregated complexity score:
Min | | | | | Max
Seasonal traffic variability:
Min | | | | | Max

Trend in gate-to-gate economic cost-effectiveness (all financial data in €2016 prices)

ATFM delay costs per composite flight-hour
ATM/CNS provision costs per composite flight-hour

Year	ATFM delay costs per composite flight-hour	ATM/CNS provision costs per composite flight-hour	Total cost per composite flight-hour
2011	160	640	800
2012	168	673	841
2013	172	688	860
2014	170	685	855
2015	174	694	868
2016	168	672	840

ATM/CNS provision costs
Unit costs of ATFM delays
Composite flight-hours

Period	ATM/CNS provision costs	Unit costs of ATFM delays	Composite flight-hours
2011-12	+3.9%	-1.1%	-0.5%
2012-13	-2.6%	-2.4%	-0.5%
2013-14	+3.2%	+1.0%	-11.3%
2014-15	+0.05%	+0.7%	+6.9%
2015-16	-1.4%	-12.6%	+1.1%

Trend in gate-to-gate ATCO-hour productivity

Composite flight-hours per ATCO-hour on duty

Year	Composite flight-hours per ATCO-hour on duty
2011	1.07
2012	1.03
2013	1.00
2014	1.00
2015	0.98
2016	1.01

Index composite flight-hours
Index number of ATCOs in OPS
Index ATCOs in OPS hours on duty

Year	Index composite flight-hours	Index number of ATCOs in OPS	Index ATCOs in OPS hours on duty
2011	100	100	100
2012	98	104	103
2013	96	104	103
2014	97	104	104
2015	98	100	107
2016	99	103	106

Trend in gate-to-gate employment costs per ATCO-hour

€ per ATCO-hour on duty (2016 prices)

Year	€ per ATCO-hour on duty (2016 prices)
2011	164
2012	176
2013	176
2014	179
2015	172
2016	184

ATCO-hours on duty per ATCO per year

Year	ATCO-hours on duty per ATCO per year
2011	1246
2012	1227
2013	1236
2014	1243
2015	1332
2016	1275

Trend in support costs per composite flight-hour

€ per composite flight hour (2016 prices)

Year	Exceptional costs	Capital-related costs	Employment costs (excl. ATCOs in OPS)	Total cost per composite flight-hour
2011	120	120	260	500
2012	126	126	280	532
2013	122	122	276	520
2014	128	128	280	536
2015	126	126	279	531
2016	122	122	266	510

Changes in components of support costs (2011-2016)

Million €

Component	Percentage change
Employment costs for support staff	+4.9%
Non-staff operating costs	-17.9%
Depreciation costs	-18.9%
Cost of capital	+2.9%
Exceptional costs	+995.1%

Changes in financial cost-effectiveness (2015-2016)

ATCO-hour productivity
Employment costs per ATCO-hour

Component	Percentage change
ATCO-hour productivity	+2.5%
Employment costs per ATCO-hour	+6.9%

ATCO employment costs per composite flight-hour

Component	Percentage change
ATCO employment costs per composite flight-hour	+4.3%

Decrease in unit ATM/CNS provision costs 2015-2016

Component	Percentage change
Decrease in unit ATM/CNS provision costs 2015-2016	-2.5%

Support costs per composite flight-hour

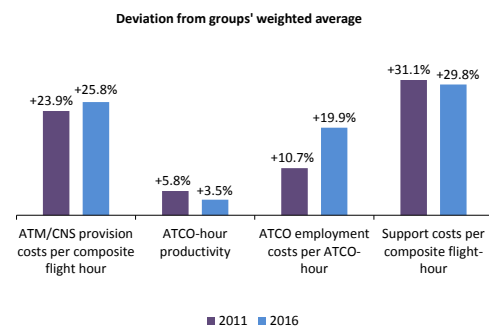
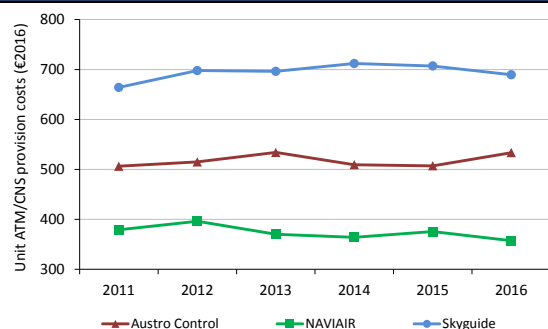
Component	Percentage change
Support costs per composite flight-hour	-4.7%

"Support costs effect"
"Traffic effect"

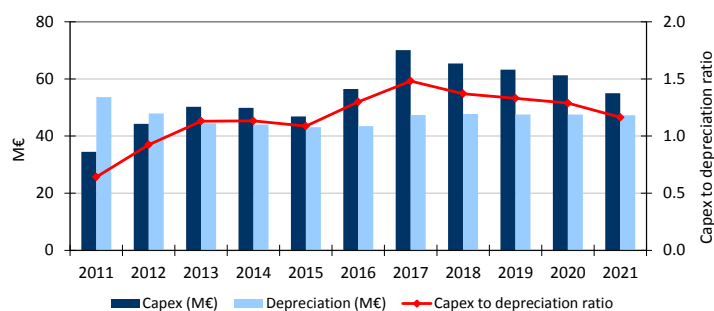
Component	Percentage change
"Support costs effect"	-3.7%
"Traffic effect"	+1.1%

Skyguide (Switzerland) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDP5	HMI	VCS
							C: 1999 (Geneva) 2007 (Zurich)*	C: 2004 (All ACCs)*	C: 2003/2006 (All ACCs)*	C: 2004/2005 (All ACCs)*
€271.5M (2005-2022)	€26.8M	€3.1M	€16.1M (2010-2020)	€4.1M		2011				
						2012				
						2013				
						2014				
						2015	Geneva		Geneva	All ACCs
						2016	All ACCs	All ACCs	All ACCs	
						2017	Geneva		All ACCs	All ACCs
						2018	Zurich			
						2019				
						2020	All ACCs	All ACCs	All ACCs	All ACCs
						2021				

* C = Commissioning

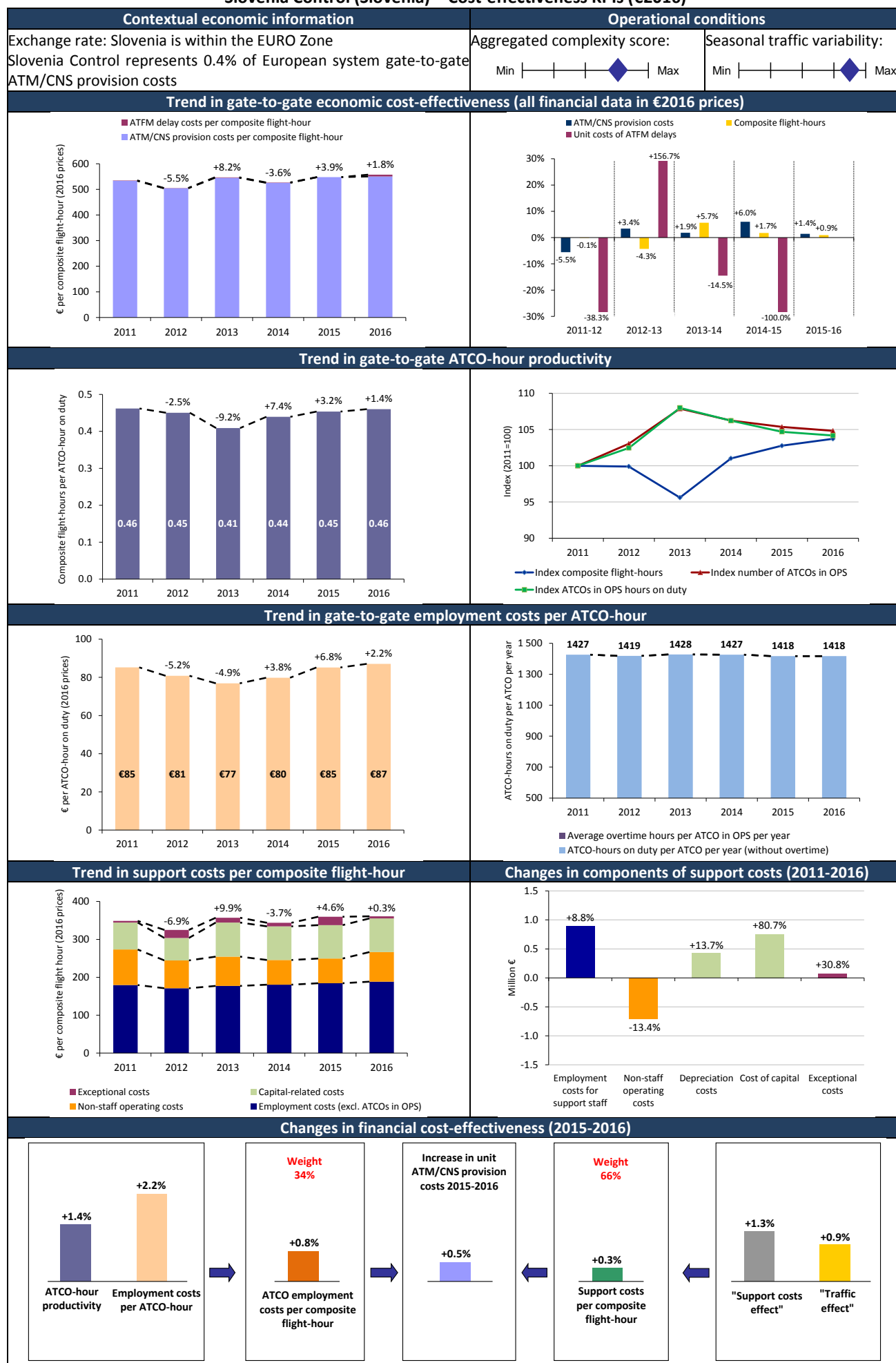
Upgrade

Replacement

Focus on the top five capex projects

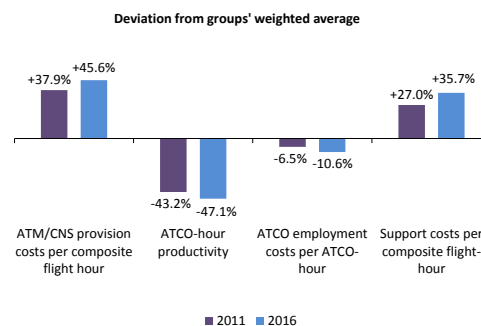
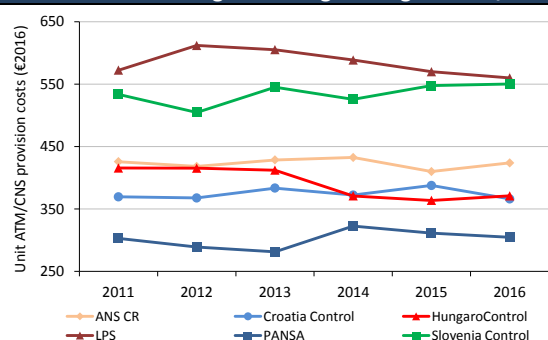
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	Virtual Centre tranche 2	ATM	93.6	2011	2020
2	Virtual Centre 1	ATM	52.4	2011	2017
3	NETWORK Evolutions	ATM	39.0	2005	2020
4	Virtual Centre tranche 3 & 4	ATM	34.4	2014	2022
5	Smart Radio	COM	25.0	2012	2021

Slovenia Control (Slovenia) – Cost-effectiveness KPIs (€2016)

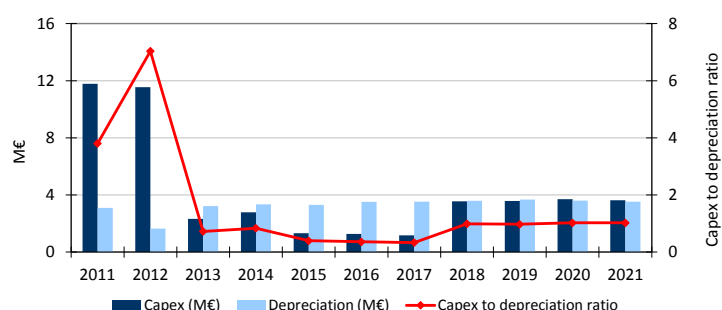


Slovenia Control (Slovenia) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Building	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2007*	C: 2000*	C: 2000*	C: 1998*
€6.9M (2006-2013)	€4.1M (2010-2020)	€1.8M (2009-2012)		€22.7M (2006-2013)		2011				
						2012				
						2013				
						2014				
			€1.0M			2015				
						2016				
€8.1M					€2.9M	2017				
						2018				
						2019				
						2020				
						2021				

* C = Commissioning

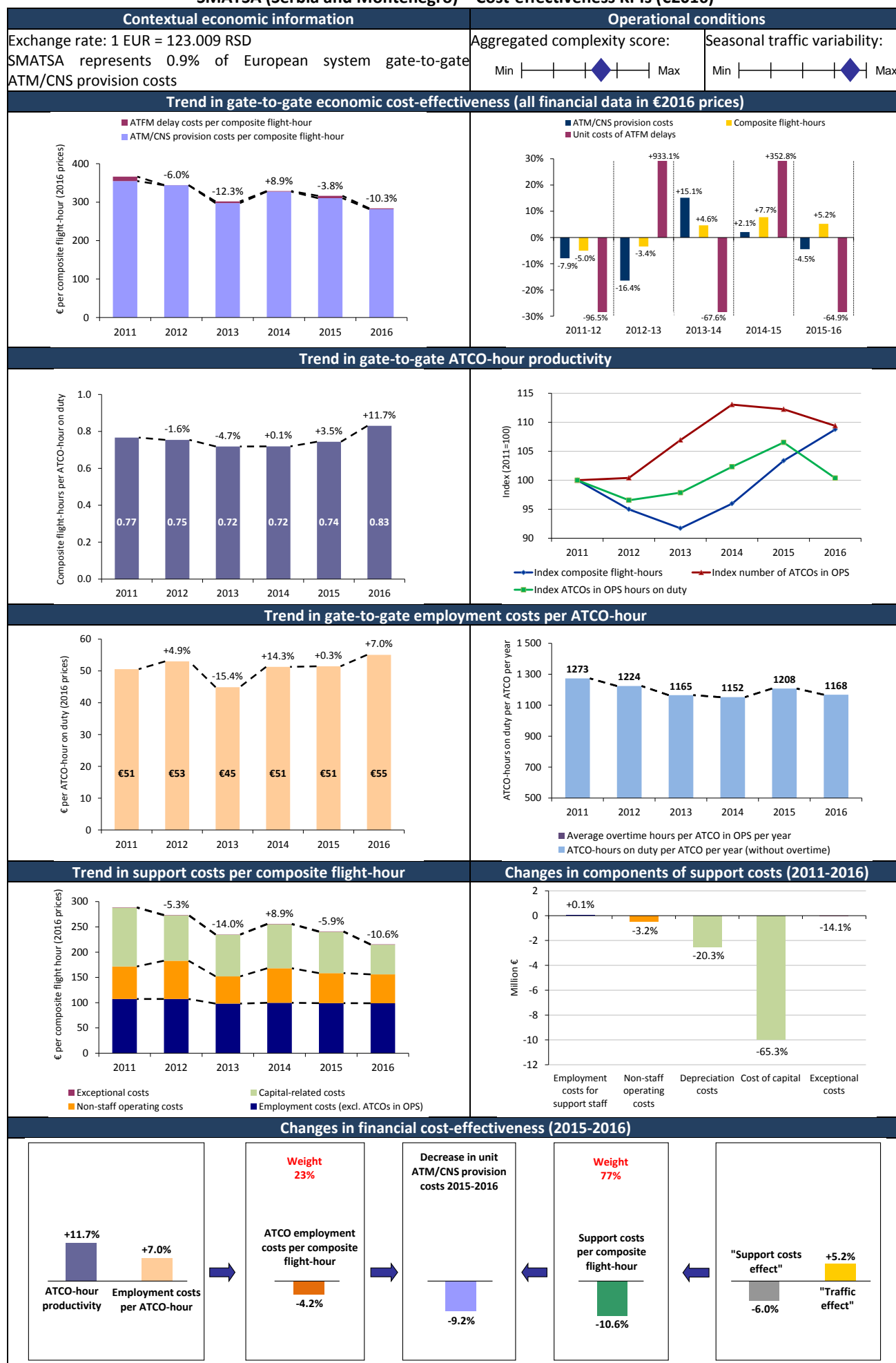
Upgrade

Replacement

Focus on the top five capex projects

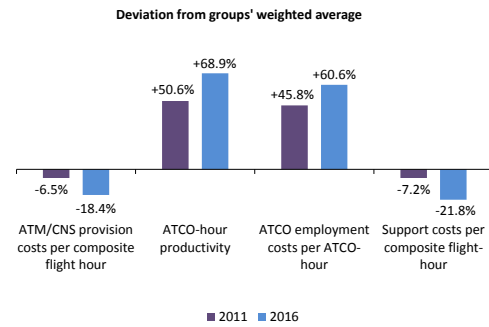
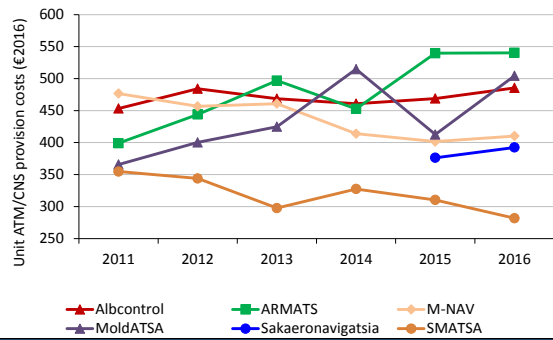
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	New ATCC building in Ljubljana (including general equipment)	Buildings	22.7	2006	2013
2	New ATCC technical systems	ATM	6.9	2006	2013
3	ATM System upgrade	ATM	4.6	2018	2020
4	Datalink/CPDLC	COM	2.5	2014	2018
5	FDPS Upgrade	ATM	2.2	2015	2017

SMATSA (Serbia and Montenegro) – Cost-effectiveness KPIs (€2016)

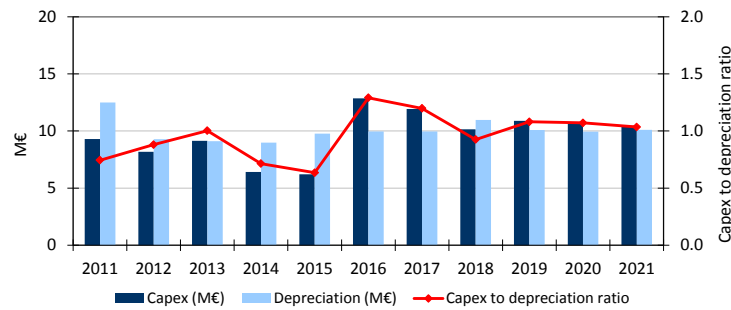


SMATSA (Serbia and Montenegro) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS	RDPS	HMI	VCS
							C: 2011*	C: 2011*	C: 2011*	C: 2011*
€42.1M (2008-2011)						2011				
						2012				
			€2.1M			2013				
				€21.9M (2009-2017)		2014				
€23.0M	€3.3M					2015				
		€4.7M				2016				
						2017				
	€3.8M					2018				
					€7.9M	2019				
						2020				
						2021				

* C = Commissioning

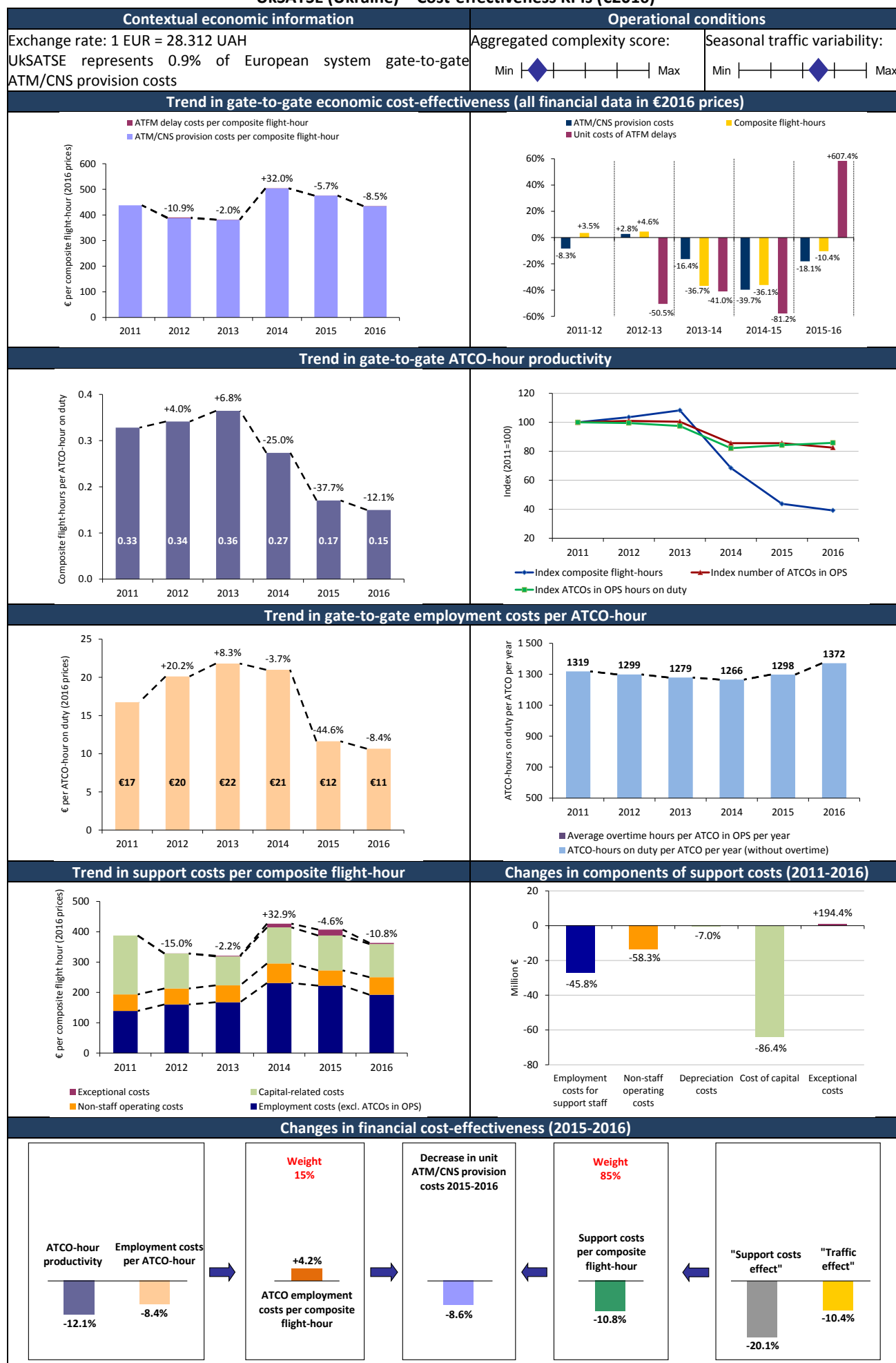
Upgrade

Replacement

Focus on the top five capex projects

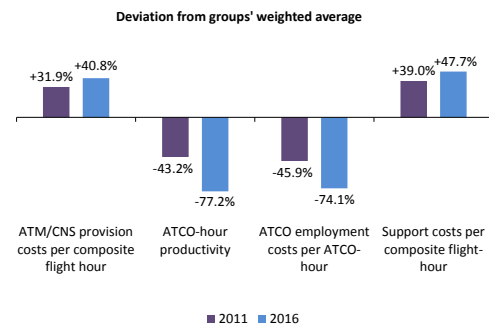
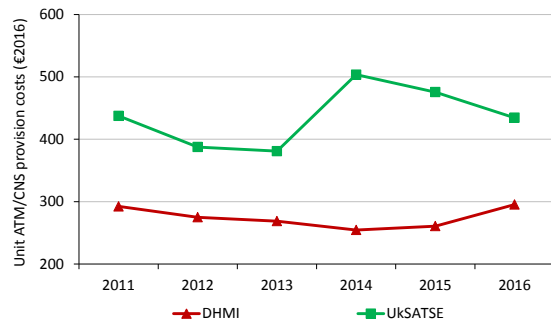
Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	New ATM System for Belgrade ACC and SMATSA communications network	ATM	28.4	2009	2011
2	New ATCC in Belgrade	Buildings	16.2	2009	2010
3	Aircraft equipped with Automatic Flight Inspection System	ATM	9.2	2008	2010
4	Electricity infrastructure around runways in Belgrade, Ponikve, Tivat and Podgorica	Other	7.9	2018	2020
5	Top Sky ATC system upgrade	ATM	7.8	2016	2017

UKSATSE (Ukraine) – Cost-effectiveness KPIs (€2016)

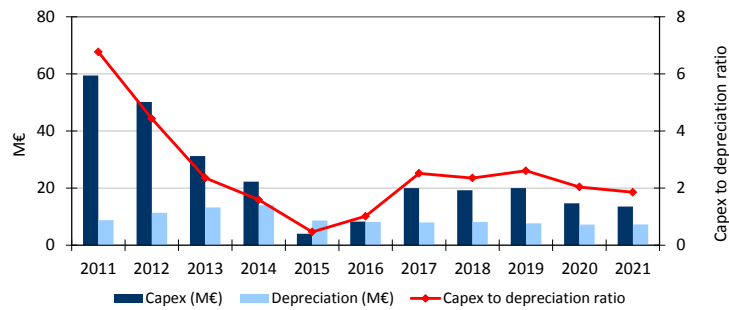


UKSATSE (Ukraine) – (€2016)

Changes in unit gate-to-gate ATM/CNS provision costs within comparator group



Planned capital expenditures and depreciation costs



Information on major capex projects and ATM systems upgrades/replacements

ATM	COM	NAV	SUR	Buildings	Other	Years	FDPS C: 2000 (Odessa), 2007 (Kyiv and Dnip.), 2016 (L'viv)*	RDPS C: 2000 (Odessa), 2007 (Kyiv and Dnip.), 2016 (L'viv)*	HMI C: 2000 (Odessa), 2007 (Kyiv and Dnip.), 2016 (L'viv)*	VCS C: 2003 (Odessa), 2007 (Dnip.), 2011 (Kyiv), 2016 (L'viv)*
€8.6M (2008-2018)	€10.3M	€1.3M	€17.3M		€3.3M	2011				K
						2012	K	K	K	
						2013	D	D	D	
						2014	K	K	K	
						2015				K
						2016	L	L	L	L
						2017				K
						2018	O	O	O	O, D
						2019				D
						2020				
						2021				

* C = Commissioning Upgrade Replacement

Focus on the top five capex projects

Project number	Name of the project	Domain	Capex spent between start and end dates (€M)	Start date	End date
1	PSR/SSR Mode S (EHS) and SSR Mode S (EHS)	SUR	7.4	2017	2020
2	Receiving-transmitting radio centres with VoIP function	COM	5.5	2017	2019
3	Implementation of 3 new Monopulse Secondary Surveillance Radars with Mode S (EHS)	SUR	5.1	2016	2018
4	Upgrade of surveillance systems in Bar, Dubno, Bahmach, Znamenka, Chuguyiv	SUR	4.8	2013	2019
5	ATCO simulator for Kyiv ATM Centre	ATM	3.9	2016	2018

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ANNEX 1 – STATUS OF ANSPs 2016 ANNUAL REPORTS

	Availability of a public Annual Report (AR)	Availability of Management Report	Availability of Annual Accounts	Independent audited accounts	Separate disclosure of en-route and terminal ANS costs	Information provided in English	PRU comments
Albcontrol	✓	✓	✓	✓	No	✓	
ANS CR	✓	✓	✓	✓	No	✓	
ARMATS	No	No	No	No	No	No	PRU received an extract of the Financial Statements comprising an Income and a Balance Sheet statement.
Austro Control	✓	✓	✓	✓	No	✓	
Avinor	✓	✓	✓	✓	No	✓	Detailed accounts are available for Avinor Group, which include airport activities. On top of this information, the PRU received an extract of the Financial Statements comprising an Income, a Balance Sheet and a Cash Flow statement for Avinor Flysikring which is the ANS division of Avinor.
Belgocontrol	✓	✓	✓	✓	No	✓	Audit performed by the “board of auditors”. No cash flow statement.
BULATSA	✓	✓	✓	✓	No	✓	
Croatia Control	✓	✓	✓	✓	No	✓	
DCAC Cyprus	No	No	No	No	No	No	DCAC annually discloses a report which includes some financial information from Route Charges Document but not Financial Statements.
DFS	✓	✓	✓	✓	No	✓	Separate accounts are used for internal reporting purposes and charges calculation.
DHMI	✓	✓	✓	✓	No	✓	Includes airport activities, audit performed by the “Court of Accountants”.
DSNA	No	No	No	No	No	No	DSNA 2016 Annual Report comprising audited Financial Statements was not available at the time of writing this report.
EANS	✓	✓	✓	✓	✓	✓	Disclosure of total revenues and costs for en-route and terminal ANS.
ENAIRE	✓	✓	✓	✓	No	✓	A document with an extract of the Financial Statements is available in English. Detailed annual accounts are available in Spanish.
ENAV	✓	✓	✓	✓	No	✓	
Finavia	✓	✓	✓	✓	No	✓	Detailed accounts are available for Finavia Group and Corporation, which include airport activities.
HCAA	No	No	No	No	No	No	
HungaroControl	✓	✓	✓	✓	No	✓	
IAA	✓	✓	✓	✓	No	✓	
LFV	✓	✓	✓	✓	No	✓	
LGS	✓	✓	✓	✓	No	✓	
LPS	✓	✓	✓	✓	No	✓	
LVNL	✓	✓	✓	✓	✓	No	Separate disclosure of aggregated figures for en-route and terminal ANS.
MATS	✓	✓	✓	✓	✓	✓	
M-NAV	No	No	No	No	No	No	
MoldATSA	No	No	No	No	No	No	PRU received an extract of the Financial Statements.
MUAC	✓	✓	✓	✓	n/appl	✓	
NATS	✓	✓	✓	✓	✓	✓	Several Annual Reports for individual group companies.
NAV Portugal	✓	✓	✓	✓	✓	No	Separate disclosure of aggregated figures for en-route and terminal ANS. English version of the Annual Report was not available at the time of writing this report.
NAVIAIR	✓	✓	✓	✓	✓	✓	Separate disclosure of aggregated figures for en-route and terminal ANS.
Oro Navigacija	✓	✓	✓	✓	✓	✓	Separate disclosure of aggregated figures for en-route and terminal ANS.
PANSA	✓	✓	✓	✓	No	✓	
ROMATSA	✓	✓	✓	✓	No	✓	
Sakaeronavigatsia	No	No	✓	✓	No	✓	PRU received a document comprising detailed Financial Statements together with the independent Auditors’ Report.
Skyguide	✓	✓	✓	✓	✓	✓	Separate disclosure of aggregated figures for en-route and terminal ANS and military OAT services.
Slovenia Control	✓	✓	✓	✓	No	✓	
SMATSA	✓	✓	✓	✓	No	✓	
UkSATSE	✓	✓	✓	✓	No	✓	Annual Report does not include Financial Statements. UkSATSE provided a separate document with Financial Statements.

Annex 1 - Table 0.1: Status on ANSP’s 2016 Annual Reports

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ANNEX 2 – PERFORMANCE INDICATORS USED FOR THE COMPARISON OF ANSPs

The output measures for ANS provision are, for en-route, the en-route flight-hours controlled²⁸ and, for terminal ANS, the number of IFR airport movements controlled. In addition to those output metrics, it is important to consider a "gate-to-gate" perspective, because the boundaries used to allocate costs between en-route and terminal ANS vary between ANSPs and might introduce a bias in the cost-effectiveness analysis²⁹.

For this reason, an indicator combining the two separate output measures for en-route and terminal ANS provision has been calculated. The "composite gate-to-gate flight-hours" are determined by weighting the output measures by their respective average cost of the service for the whole Pan-European system. This average weighting factor is based on the total monetary value of the outputs over the period 2002-2016 and amounts to 0.27.

The composite gate-to-gate flight-hours are consequently defined as:

$$\text{Composite gate-to-gate flight-hours} = \text{En-route flight-hours} + (0.27 \times \text{IFR airport movements})$$

In the ACE 2001-2006 Reports, two different weighting factors were used to compute ANSPs cost-effectiveness: one for the year under study and another to examine changes in performance across time. As the ACE data sample became larger in terms of years, the difference between these two weighting factors became insignificant. For the sake of simplicity, it was therefore proposed in the ACE 2007 Benchmarking Report to use only one weighting factor to analyse ANSPs performance for the year and to examine historical changes in cost-effectiveness.

Although the composite gate-to-gate output metric does not fully reflect all aspects of the complexity of the services provided, it is nevertheless the best metric currently available for the analysis of gate-to-gate cost-effectiveness³⁰.

For the sake of completeness, the gate-to-gate financial cost-effectiveness indicator is broken down into en-route and terminal components. To facilitate the comparison and interpretation of the results, ANSPs are ranked according to the en-route cost-effectiveness indicator. The output units in the Figure below are en-route flight-hours and IFR airport movements, respectively.

The Figure below shows that there are cases where a high en-route cost per flight-hour (top graph) corresponds to a low terminal cost per IFR airport movement (bottom graph) and vice versa. For example Sakaeronavigatsia has relatively high unit costs in terminal service provision but relatively low unit costs in en-route.

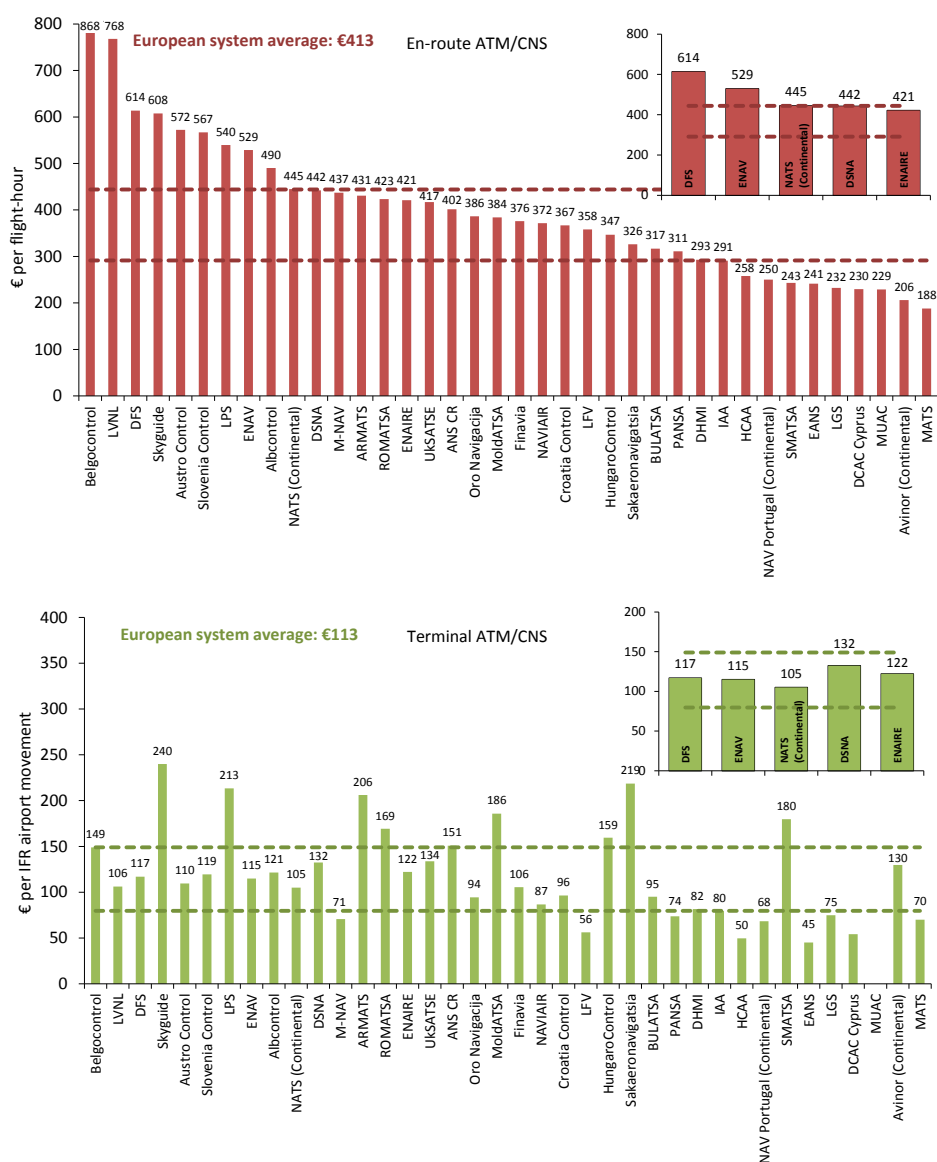
It is difficult to determine whether these differences are driven by economic and operational factors (for example, size of operations, economies of scale, or traffic complexity), or purely

²⁸ Controlled flight-hours are calculated by the Network Manager (NM) as the difference between the exit time and entry time of any given flight in the controlled airspace of an operational unit. Three types of flight-hours are currently computed by the NM (filed model, regulated model and current model). The data used for the cost-effectiveness analysis is based on the current model (Model III or CFTM) and includes flight-hours controlled in the ACC, APP and FIS operational units which are described in the NM environment.

²⁹ See also working paper on "Cost-effectiveness and Productivity Key Performance Indicators", available on the PRC web site at <http://www.eurocontrol.int/ansperformance/prc>.

³⁰ Further details on the theoretical background to producing composite indicators can be found in a working paper on "Total Factor Productivity of European ANSPs: basic concepts and application" (Sept. 2005).

cost-allocation differences, which are known to exist across States/ANSPs. For this reason, the focus of the cost-effectiveness benchmarking analysis in this report is “gate-to-gate”.



Annex 2 - Figure 0.1: Breakdown of financial cost-effectiveness into en-route and terminal, 2016

The quality of service provided by ANSPs has an impact on the efficiency of aircraft operations, which carry with them additional costs that need to be taken into consideration for a full economic assessment of ANSP performance. In this ACE Benchmarking Report, an indicator of “economic” cost-effectiveness is computed at ANSP and Pan-European system levels by adding the ATM/CNS provision costs and the costs of ATFM ground delay³¹, all expressed per composite flight-hour. This computation is shown in the Table below (see column 10). It should be noted

³¹ The ATFM delays analysed in this ACE Benchmarking Report do not comprise changes due to the Post Operations Performance Adjustment Process. This process allows operational stakeholders to notify national and European authorities of issues that relate to ATFM delay measurement, classification and assignment. The minutes of ATFM delays resulting from this process would lead to different unit economic costs figures for some ANSPs. For instance, if the Post-Ops changes would be taken into account, ENAIRES 2016 unit economic costs would amount to €498 instead of €504. Detailed information on this process is available on the Network Manager website at the following link: <http://www.eurocontrol.int/publications/post-operations-performance-adjustment-process>.

that the ATFM delays included in the ACE data analysis reflect all delay causes (e.g. capacity, weather, etc.). Detailed information on causes of ATFM delays at ACC level is provided in the PRC Performance Review Reports.

ANSPs	(1) Gate-to-gate ATM/CNS provision costs (in €'000)	(2) En-route ATFM delays (in '000 minutes)	(3) Airport ATFM delays (in '000 minutes)	(4)=(2)+(3) Total ATFM delays (in '000 minutes)	(5) % share in European system ATFM delays	(6)=(4)×€100 Costs of ATFM delays (in €'000)	(7) Composite flight-hours (in '000)	(8)=(1)/(7) Financial gate-to- gate cost- effectiveness	(9)=(6)/(7) Costs of delay per composite flight-hour	(10)=(8)×(9) Economic costs per composite flight-hour
Albcontrol	22 029	0	0	0	0.0%	0	45	485	0	485
ANS CR	123 731	6	1	7	0.0%	743	292	424	3	426
ARMATS	8 269	0	0	0	0.0%	0	15	540	0	540
Austro Control	195 879	53	118	171	1.1%	17 112	367	533	47	580
Avinor (Continental)	160 585	68	101	168	1.1%	16 849	542	296	31	328
Belgocontrol	147 084	288	124	412	2.7%	41 207	204	722	202	924
BULATSA	89 691	4	0	4	0.0%	415	280	320	1	321
Croatia Control	84 671	21	0	21	0.1%	2 149	231	366	9	375
DCAC Cyprus	38 699	204	18	222	1.4%	22 179	171	227	130	357
DFS	1 092 373	1 126	455	1 581	10.3%	158 133	1 936	564	82	646
DHMI	467 058	0	1 961	1 961	12.8%	196 120	1 582	295	124	419
DSNA	1 253 962	3 602	567	4 170	27.1%	416 962	2 778	451	150	602
EANS	18 117	5	0	5	0.0%	491	78	232	6	238
ENAIRE	757 539	776	554	1 330	8.7%	133 025	1 768	428	75	504
ENAV	684 317	4	88	92	0.6%	9 207	1 357	504	7	511
Finavia	63 853	0	23	23	0.1%	2 282	167	382	14	396
HCAA	146 099	96	450	547	3.6%	54 653	600	244	91	335
HungaroControl	97 820	57	0	58	0.4%	5 759	264	371	22	393
IAA	110 715	0	20	20	0.1%	1 988	379	292	5	297
LFV	180 009	50	44	94	0.6%	9 370	555	324	17	341
LGS	22 400	0	0	0	0.0%	31	93	241	0	242
LPS	59 407	15	0	15	0.1%	1 500	106	560	14	574
LVNL	182 594	58	535	592	3.9%	59 227	307	595	193	788
MATS	17 926	0	0	0	0.0%	46	91	198	1	198
M-NAV	11 771	1	0	1	0.0%	96	29	410	3	414
MoldATSA	7 790	0	0	0	0.0%	0	15	504	0	504
MUAC	143 246	987	n/appl	987	6.4%	98 731	626	229	158	387
NATS (Continental)	800 160	705	1 053	1 758	11.4%	175 798	1 850	432	95	528
NAV Portugal (Continental)	117 264	119	123	242	1.6%	24 189	467	251	52	303
NAVIAIR	111 502	0	4	4	0.0%	398	312	357	1	358
Oro Navigacija	25 709	0	0	0	0.0%	0	68	379	0	379
PANSA	158 687	292	41	333	2.2%	33 270	521	305	64	368
ROMATSA	172 782	0	19	19	0.1%	1 893	385	449	5	453
Sakaeronavigatsia	23 104	0	0	0	0.0%	0	59	392	0	392
Skyguide	317 091	114	402	516	3.4%	51 607	460	689	112	802
Slovenia Control	32 307	4	0	4	0.0%	356	59	550	6	556
SMATSA	73 239	5	0	5	0.0%	531	260	282	2	284
UKSATSE	72 467	0	1	1	0.0%	116	167	434	1	435
Total Pan-European System	8 091 946	8 661	6 703	15 364	100%	1 536 431	19 487	415	79	494

Annex 2 - Table 0.1: Economic cost-effectiveness indicator, 2016

The cost of ATFM delay in this report is based on the **European airline delay cost reference values**, published by the University of Westminster. Based on the initial work published in 2004³², the report has been updated in 2011 to improve the methodology and to take changes in the economic and regulatory environment into account. In each new ACE report, the PRU expresses the cost of one minute of ATFM delay in the price base of the year under review, using the average European Union inflation rate published by EUROSTAT (e.g. in the ACE 2013 report, the €81 per minute corresponding to the 2011 value amounted to €87 when expressed in 2013 prices).

In December 2015, a further updated has been published to update the 2011 delay costs with 2014 values³³. Based on this latest update, the estimated average European ATFM delay cost have been adjusted from €81 per minute (2011 value) to €100 per minute (2016 value). The increase in estimated ATFM delay costs is mainly driven by an increase in passenger delay costs (rebooking, compensation and care, etc.) which is the single largest group of costs, followed by reactionary, crew and maintenance costs. ATFM delays are only marginally affected by changes in jet fuel price as they primarily occur at the gate.

More detailed information can be found in the updated University of Westminster report, available for download on the PRC web-page (<http://www.eurocontrol.int/ansperformance/prc>).

³² Evaluating the true cost to airlines of one minute of airborne or ground delay (May 2004).

³³ European airline delay cost reference values (December 2015), available at: <http://www.eurocontrol.int/publications/european-airline-delay-cost-reference-values>.

It is important to note that in this ACE 2016 Benchmarking Report, the changes in ATFM delays observed between 2015 and 2016 are affected by a change in the methodology used by the EUROCONTROL Network Manager (NM) to calculate delays which was implemented in April 2016. At system level, this change resulted in substantially less ATFM delays compared to those computed for the previous years.

As indicated in Section 2.3: “ANSPs noticed that the use of the Ready Message (REA) - whilst attempting to improve punctuality for aircraft – could result in artificial changes to the computed ATFM delay for individual flights and for the ANSP that has requested the regulation. The ANSPs brought this to the attention of the Network Management Board (NMB). The ANSPs, together with the airspace users and the Network Manager reviewed the existing situation and developed a more accurate process which avoids artificial changes to the computed ATFM delay when a REA message is used. The more accurate process was presented to the NMB and approved in March 2015 for implementation with NM software release 20.0 on April 04 2016.”

For benchmarking purposes and time series analysis, it is therefore not correct to compare ATFM delays recorded for 2015 and 2016 in the NM database in a straightforward manner since these figures are not computed using a consistent methodology. The approach which is taken in the ACE analysis in order to address this issue is the following:

- ATFM delays computed according to the new methodology are used when presenting results in terms of economic cost-effectiveness for the year 2016 in the cross-section analysis; while,
- In order to ensure consistency in time series analysis, 2016 delays have been computed using the old methodology to analyse changes in unit economic costs at ANSP and Pan-European system levels.

For the sake of transparency, the Table below presents ANSPs 2016 unit economic costs computed using the old NM methodology (see columns shaded in light grey).

ANSPs	(1) Gate-to-gate ATM/CNS provision costs (in '€'000)	(2) En-route ATFM delays ('000 minutes)	(3) Airport ATFM delays ('000 minutes)	(4)=(2)+(3) Total ATFM delays ('000 minutes)	(5) % share in European system ATFM delays	(6)=(4)×€100 Costs of ATFM delays (in '€'000)	(7) Composite flight-hours (in '000)	(8)=(1)/(7) Financial gate-to- gate cost- effectiveness	(9)=(6)/(7) Costs of delay per composite flight-hour	(10)=(8)×(9) Economic costs per composite flight-hour
Albcontrol	22 029	0	0	0	0.0%	0	45	485	0	485
ANS CR	123 731	7	1	8	0.0%	838	292	424	3	427
ARMATS	8 269	0	0	0	0.0%	0	15	540	0	540
Austro Control	195 879	59	128	187	1.1%	18 740	367	533	51	584
Avinor (Continental)	160 585	79	120	199	1.2%	19 877	542	296	37	333
Belgocontrol	147 084	334	136	470	2.7%	46 954	204	722	230	952
BULATSA	89 691	5	0	5	0.0%	512	280	320	2	322
Croatia Control	84 671	26	0	26	0.2%	2 585	231	366	11	377
DCAC Cyprus	38 699	227	22	249	1.4%	24 858	171	227	146	372
DFS	1 092 373	1 302	502	1 804	10.5%	180 376	1 936	564	93	657
DHMI	467 058	0	2 088	2 088	12.1%	208 826	1 582	295	132	427
DSNA	1 253 962	3 962	614	4 575	26.6%	457 547	2 778	451	165	616
EANS	18 117	6	0	6	0.0%	621	78	232	8	240
ENAIRE	757 539	873	636	1 508	8.8%	150 831	1 768	428	85	514
ENAV	684 317	4	93	97	0.6%	9 719	1 357	504	7	511
Finavia	63 853	0	26	26	0.2%	2 588	167	382	16	398
HCAA	146 099	118	511	629	3.7%	62 935	600	244	105	348
HungaroControl	97 820	73	0	73	0.4%	7 323	264	371	28	399
IAA	110 715	0	22	22	0.1%	2 219	379	292	6	298
LFV	180 009	51	47	98	0.6%	9 798	555	324	18	342
LGS	22 400	0	0	0	0.0%	33	93	241	0	242
LPS	59 407	18	0	18	0.1%	1 798	106	560	17	577
LVNL	182 594	69	633	702	4.1%	70 230	307	595	229	824
MATS	17 926	0	0	0	0.0%	48	91	198	1	198
M-NAV	11 771	1	0	1	0.0%	113	29	410	4	414
MoldATSA	7 790	0	0	0	0.0%	0	15	504	0	504
MUAC	143 246	1 200	n/appl	1 200	7.0%	119 982	626	229	192	421
NATS (Continental)	800 160	790	1 130	1 920	11.2%	191 988	1 850	432	104	536
NAV Portugal (Continental)	117 264	137	135	273	1.6%	27 278	467	251	58	309
NAVIAIR	111 502	0	4	4	0.0%	430	312	357	1	358
Oro Navigacija	25 709	0	0	0	0.0%	0	68	379	0	379
PANSA	158 687	342	45	387	2.3%	38 725	521	305	74	379
ROMATSA	172 782	0	21	21	0.1%	2 149	385	449	6	454
Sakaeronavigatsia	23 104	0	0	0	0.0%	0	59	392	0	392
Skyguide	317 091	127	455	582	3.4%	58 183	460	689	127	816
Slovenia Control	32 307	4	0	4	0.0%	414	59	550	7	557
SMATSA	73 239	6	0	6	0.0%	563	260	282	2	284
UkSATSE	72 467	0	1	1	0.0%	143	167	434	1	435
Total Pan-European System	8 091 946	9 820	7 373	17 192	100%	1 719 223	19 487	415	88	503

Annex 2 - Table 0.2: Economic cost-effectiveness indicators based on old NM methodology, 2016

Finally, it is noteworthy that this issue is not expected to significantly affect the ACE 2017 Benchmarking Report since both 2016 and 2017 ATFM delays will be computed using the new methodology implemented by the NM.

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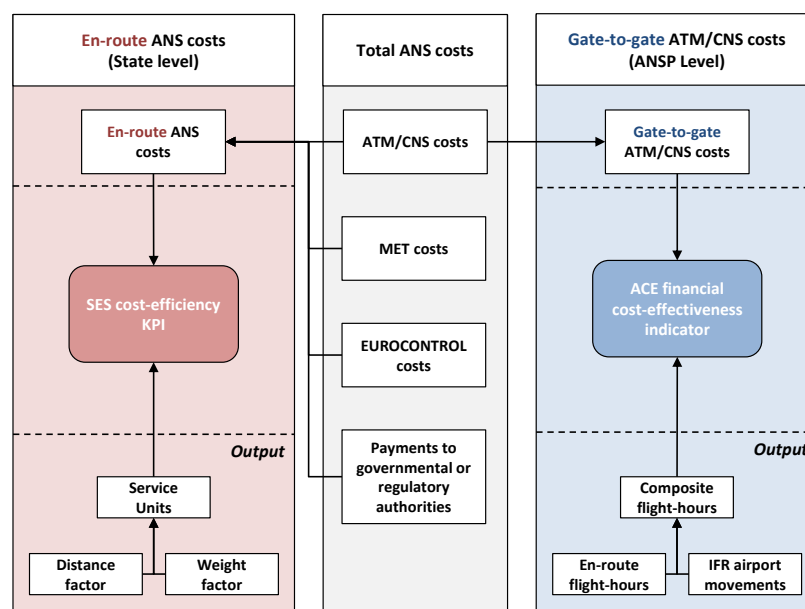
ANNEX 3 – ACE COST-EFFECTIVENESS INDICATOR AND SES COST-EFFICIENCY KPI

The objective of this Annex is to explain the main differences between the ACE financial cost-effectiveness indicator and the Single European Sky (SES) en-route cost-efficiency KPI (as defined in Regulation (EU) N°390/2013).

First of all, it should be noted that these two indicators have been specified in response to different needs:

- The purpose of the ACE analysis is to benchmark the cost-effectiveness performance of ANSPs in providing gate-to-gate ATM/CNS services (where en-route and terminal ATM/CNS are considered together). The ACE financial cost-effectiveness indicator is computed as the ratio of ATM/CNS provision costs to composite flight-hours and it can be broken down into three components (ATCO-hour productivity, ATCO employment costs per ATCO-hour and unit support costs). These components allow interpreting the differences in cost-effectiveness performance observed across Pan-European ANSPs. The ACE benchmarking analysis also informs ATM stakeholders on the level and trends of the Pan-European system cost-effectiveness performance.
- The en-route cost-efficiency KPI (the Determined Unit Cost or DUC), which is defined in the Performance Scheme regulation, is used as part of the SES cost-efficiency performance target-setting and monitoring processes. This KPI is computed as the ratio of en-route ANS costs (in real terms) to service units at charging zone level, and reflects the costs of several entities, not only the ANSP. The en-route ANS costs (in nominal terms) and service units also form the basis to calculate the unit rate that is billed to airspace users within a charging zone.

The methodology used to compute the two indicators is illustrated in the Figure below.



Annex 3 - Figure 0.1: ACE cost-effectiveness indicator and SES cost-efficiency KPI

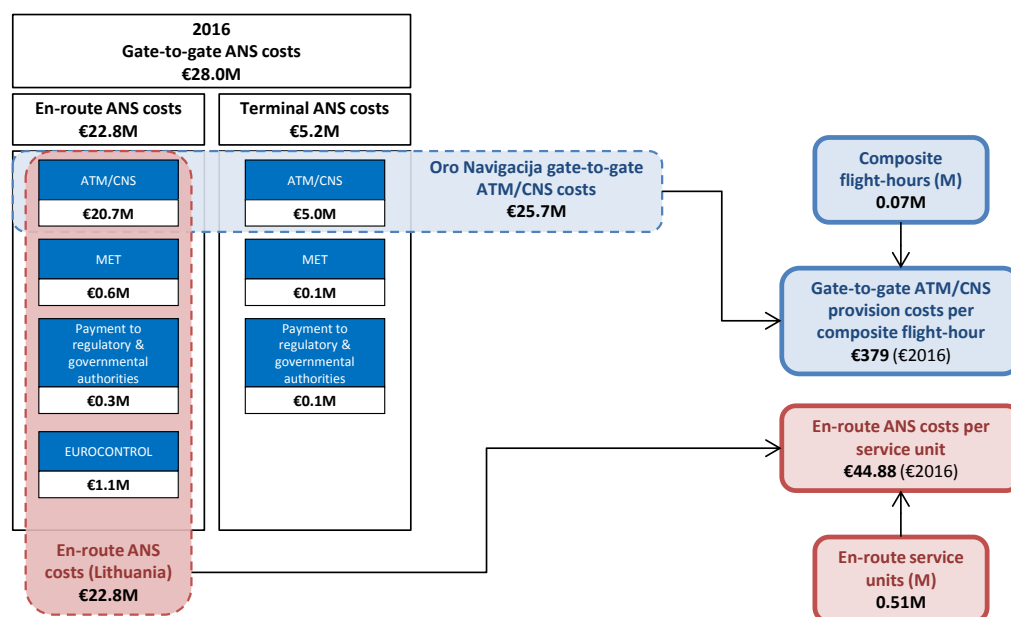
As shown in the Figure above, the main differences between the ACE financial cost-effectiveness indicator and the SES en-route cost-efficiency KPI are the following:

- **Operational scope:** En-route and terminal costs are considered together when benchmarking the economic performance of ANSPs in the ACE analysis. As explained in Annex 2 above, it is important to consider a "gate-to-gate" perspective, because the

boundaries used to allocate costs between en-route and terminal ANS vary between ANSPs and might introduce a bias in the cost-effectiveness analysis. On the other hand, the SES cost-efficiency KPI is computed for en-route and terminal ANS separately, for the purposes of the target-setting and/or monitoring processes.

- **Service scope:** Total ANS costs (including costs relating to the ANSPs, METSPs, EUROCONTROL, and NSAs) are used to compute the SES cost-efficiency KPI, while only the ANSPs ATM/CNS provision costs are included in the ACE benchmarking analysis.
- **Measure of the output:** The output metric used to compute the SES en-route cost-efficiency KPI is the number of en-route service units³⁴. This metric is a function of the aircraft weight and of the distance flown within a given charging zone. This is the metric which has been historically used to compute the en-route unit rate charged to airspace users. On the other hand, the ACE financial cost-effectiveness indicator is computed using composite flight-hours³⁵, which combine both flight-hours and IFR airport movements as detailed in Annex 2 above. It should be noted that the geographical area controlled by ANSPs operational units can substantially differ from the charging zones in case of delegation of ANS. The composite flight-hours therefore better reflect the operational activity performed by ANSPs, while service units are more appropriate when charging zones are considered.

The Figure below provides a concrete example of reconciliation between the ACE financial cost-effectiveness indicator and the en-route costs per service unit³⁶. It uses as an example the ACE 2016 data provided by Oro Navigacija and the 2016 actual en-route costs and service units provided by Lithuania for the purposes of the Enlarged Committee for Route Charges in November 2017. In both cases, financial information is expressed in €2016.



Annex 3 - Figure 0.2: Example of reconciliation between ANSP unit gate-to-gate ATM/CNS provision costs and a charging zone unit en-route ANS costs (2016)

³⁴ $Service\ unit = distance\ flown \times \sqrt{\frac{MTOW}{50}}$

³⁵ Further details on the calculation of the metric can be found in Annex 2 of this report.

³⁶ It should be noted that the costs reported in the UK Performance Plans and charged to en-route airspace users are based on regulatory accounting rules. This is different from the methodology used by NATS to report historic and actual ATM/CNS provision costs which are based on IFRS accounting.

ANNEX 4 – PERFORMANCE RATIOS

This Annex summarises the relationship between the three multiplicative components of financial cost-effectiveness (ATCO-hour productivity, employment costs per ATCO-hour and support cost ratio) and the two complementary components (ATCO employment costs per composite flight-hour and the support cost per composite flight-hour), described in Chapter 2. To facilitate the interpretation of the results, the concept of the “performance ratio” has been introduced.

The **performance ratios** represent the relationship between the value for an ANSP of an indicator and the value of that indicator for the Pan-European system as a whole³⁷. Performance ratios are defined such that a value **greater than one** implies a performance **better** than the Pan-European average, in terms of the positive contribution it makes to cost effectiveness. An ANSP with the **same** performance as the Pan-European system will have a performance ratio of **one**.

ANSPs	Country	Financial cost-effectiveness KPI indexes*	Performance ratios			Performance ratios	
			ATCO-hour productivity	ATCO employment costs per ATCO-hour*	Support cost ratio*	ATCO employment costs per composite flight-hour*	Support costs per composite flight-hour*
Albcontrol	AL	0.86	0.56	3.87	0.39	2.17	0.66
ANS CR	CZ	0.98	1.21	1.11	0.73	1.35	0.87
ARMATS	AM	0.77	0.17	9.30	0.49	1.56	0.62
Austro Control	AT	0.78	1.09	0.71	1.00	0.78	0.78
Avinor (Continental)	NO	1.40	1.02	1.36	1.01	1.38	1.41
Belgocontrol	BE	0.58	0.81	0.72	0.99	0.58	0.57
BULATSA	BG	1.30	0.98	1.45	0.91	1.42	1.25
Croatia Control	HR	1.13	0.85	1.18	1.13	1.00	1.21
DCAC Cyprus	CY	1.83	1.05	2.32	0.75	2.43	1.64
DFS	DE	0.74	1.30	0.50	1.13	0.65	0.79
DHMI	TR	1.41	1.22	1.78	0.65	2.16	1.21
DSNA	FR	0.92	0.90	1.11	0.92	1.00	0.89
EANS	EE	1.79	1.06	1.83	0.93	1.94	1.73
ENAIRE	ES	0.97	1.00	0.69	1.42	0.68	1.21
ENAV	IT	0.82	0.92	0.93	0.97	0.85	0.81
Finavia	FI	1.09	0.74	1.29	1.13	0.96	1.16
HCAA	GR	1.71	0.87	2.21	0.88	1.93	1.61
HungaroControl	HU	1.12	1.18	1.11	0.85	1.31	1.05
IAA	IE	1.42	1.40	1.14	0.89	1.59	1.35
LFV	SE	1.28	0.85	1.06	1.43	0.90	1.61
LGS	LV	1.72	0.93	2.96	0.62	2.76	1.46
LPS	SK	0.74	0.94	1.09	0.72	1.03	0.66
LVNL	NL	0.70	0.89	0.81	0.97	0.72	0.69
MATS	MT	2.10	1.04	2.93	0.69	3.06	1.83
M-NAV	MK	1.01	0.34	2.75	1.07	0.94	1.05
MoldATSA	MD	0.82	0.16	10.38	0.49	1.69	0.66
MUAC		1.81	2.41	0.52	1.45	1.25	2.31
NATS (Continental)	UK	0.96	1.27	0.84	0.90	1.07	0.91
NAV Portugal (Continental)	PT	1.65	1.39	0.93	1.28	1.30	1.90
NAVIAR	DK	1.16	1.18	1.08	0.91	1.28	1.11
Oro Navigacija	LT	1.10	0.60	2.43	0.75	1.47	0.98
PANSA	PL	1.36	1.12	1.16	1.05	1.30	1.40
ROMATSA	RO	0.93	0.86	1.13	0.95	0.97	0.91
Sakaeronavigatsia	GE	1.06	0.54	4.97	0.40	2.67	0.82
Skyguide	CH	0.60	1.20	0.61	0.83	0.73	0.56
Slovenia Control	SI	0.75	0.55	1.29	1.07	0.70	0.78
SMATSA	RS/ME	1.47	0.99	2.03	0.73	2.01	1.31
UKSATSE	UA	0.96	0.18	10.50	0.51	1.87	0.78
Total Pan-European System		1.00	1.00	1.00	1.00	1.00	1.00

Annex 4 – Table 0.1: The components of gate-to-gate cost-effectiveness, 2016

ANSPs for which a given component makes a particularly positive contribution to its cost-effectiveness (more than 1.30) are highlighted in green – those where a given component makes a particularly low contribution (less than 1/1.30) are in orange.

Some ANSPs more than make up for a relatively low contribution from one component by a relatively high contribution from another and, as a result, are more cost-effective than the average (cost-effectiveness index greater than 1).

³⁷ For the ATCO employment costs per ATCO-hour, the support costs ratio, the ATCO employment costs per composite flight-hour and the support costs per composite flight-hour (asterisked in the Table above), the inverse ratio is used, since **higher** unit employment costs and **higher** support costs imply **lower** cost-effectiveness performance.

On the left-hand-side the three ratios are multiplicative; the product of the ratios for each of the components equals the performance ratio for overall financial cost-effectiveness (see financial cost-effectiveness index). The following example for ENAIRE illustrates the interpretation of the performance ratios:

0.97	ENAIRE's gate-to-gate ATM/CNS costs per composite flight-hour are +3% higher ($1/0.97 - 1$) than the Pan-European average.
= 1.00	ATCO-hour productivity is in line with the Pan-European average.
x 0.69	The ATCO employment costs per ATCO-hour of ENAIRE are +45% higher ($1/0.69 - 1$) than the Pan-European average.
x 1.42	Support cost ratio is -29% lower ($1/1.42 - 1$) than the Pan-European average.

On the right-hand-side, the two complementary performance ratios are normalised using the European average (note that these ratios are neither multiplicative nor additive):

0.68	ENAIRE's ATCOs in OPS employment costs per composite flight-hour are +46% higher ($1/0.68 - 1$) than the Pan-European average, while
1.21	The support costs per composite flight-hour are -17% lower ($1/1.21 - 1$) than the Pan-European average.

ANNEX 5 – FACTORS AFFECTING PERFORMANCE

The ACE benchmarking analysis has the objective of comparing ATM cost-effectiveness performance across a wide range of ANSPs. The major focus of this report is to examine and analyse the quantitative facts about the observed cost-effectiveness performance of the ANSPs. This factual analysis provides a comprehensive description and comparison of performance as viewed by the users of ATM/CNS services.

However, such a factual analysis cannot be either a complete explanation of performance differences between ANSPs, or an exhaustive guide on how performance can be improved, without some complementary consideration of how differences in performance arose.

The framework illustrated in the Figure below, which was first introduced in the ACE 2007 Benchmarking Report, shows **exogenous** and **endogenous** factors which influence ANSP performance.

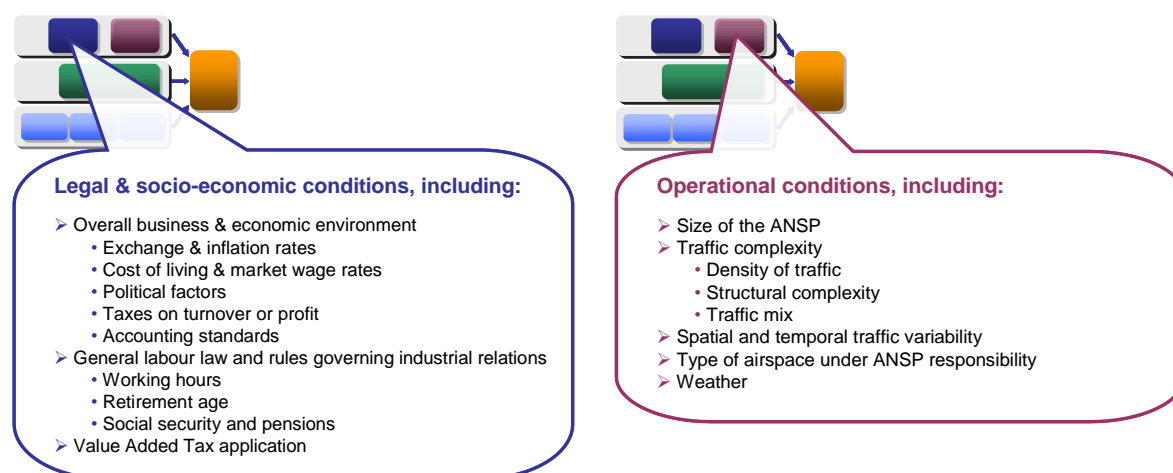


Annex 5 - Figure 0.1: Factors affecting cost-effectiveness performance

Exogenous factors are those outside the control of an ANSP whereas endogenous factors are those entirely under the ANSP's control.

Exogenous factors have been classified into two main areas according to which decision-makers have an influence over them. In particular, exogenous factors comprise:

- legal and socio-economic conditions (for example taxation policy), and operational conditions (for example traffic patterns the ANSP has to deal with) that are affected by decision makers and conditions outside aviation policy-making.



- institutional and governance arrangements such as international requirements imposed by the Single European Sky, that are influenced by aviation sector policy decisions.



The endogenous factors presented in Figure 0.1 above can be classified into three groups that should be taken into account in the scope of a comprehensive analysis of ANSPs' influence on performance:

- Organisational factors such as the internal organisation structure.
- Managerial and financial aspects such as the collective bargaining process.
- Operational and technical setup such as the operational structure.

Organisational factors, including:

- Internal organisational structure
 - Degree of centralisation
 - Optimisation of internal processes
 - Corporate culture
- Extent of in-house ownership and activities
 - Leasing, renting, owning assets
 - Research & development policy
 - Outsourcing non-core activities
- Human resources
 - Recruitment and training
 - Staff/management relationships
 - Internal communication
- Relationship with the customers
 - Arrangements for customer consultation
 - Disclosure of audited financial statements



Managerial & financial aspects, including:

- ANSP management
 - Top-management leadership and actions
 - Performance oriented management
- Collective bargaining process
- Financial and accounting aspects
 - Business planning process
 - Investment policy
 - Balance sheet structure
 - Depreciation policy



Operational & technical setup, including:

- Operational organisation
- Operational concepts and processes
 - Airspace and sector design
 - ASM, ATFM or ATFCM
 - Civil/military arrangements
- Operational flexibility
 - ATM systems & equipments
 - Human/system interaction



A more comprehensive description and analysis of the performance framework illustrated in this Annex is available in Chapter 3 of the ACE 2009 Benchmarking Report³⁸.

³⁸ Document available on the PRC website (<http://www.eurocontrol.int/publications/atm-cost-effectiveness-ace-2009>).

ANNEX 6 – TRAFFIC COMPLEXITY AND TRAFFIC VARIABILITY INDICATORS

	[1]	[2]	[3]	[4]	[5] = [2]+[3]+[4]	[6] = [1]x[5]
ANSPs	Adjusted density	Vertical interactions	Horizontal interactions	Speed interactions	Structural complexity indicator	Aggregated complexity score
Skyguide	11.47	0.26	0.63	0.22	1.11	12.70
NATS (Continental)	10.68	0.37	0.46	0.32	1.16	12.38
MUAC	10.95	0.25	0.57	0.17	0.99	10.85
DFS	9.89	0.26	0.60	0.24	1.10	10.84
Belgocontrol	7.58	0.38	0.57	0.45	1.39	10.56
LVNL	10.36	0.18	0.44	0.40	1.02	10.55
ANS CR	10.60	0.13	0.54	0.16	0.82	8.73
Austro Control	8.05	0.16	0.59	0.20	0.96	7.72
DSNA	10.94	0.14	0.45	0.11	0.70	7.69
Slovenia Control	9.34	0.09	0.60	0.13	0.81	7.60
DHMI	11.30	0.13	0.28	0.22	0.63	7.07
LPS	8.85	0.08	0.50	0.17	0.75	6.63
SMATSA	9.13	0.04	0.55	0.08	0.67	6.12
HungaroControl	8.32	0.06	0.52	0.15	0.73	6.07
ENAV	5.67	0.25	0.62	0.17	1.05	5.93
Croatia Control	7.72	0.06	0.58	0.09	0.74	5.70
BULATSA	8.77	0.07	0.35	0.15	0.57	4.96
ENAIRE	7.38	0.14	0.38	0.12	0.65	4.79
Sakaeronavigatsia	6.89	0.05	0.31	0.30	0.66	4.55
ROMATSA	6.74	0.05	0.41	0.19	0.66	4.42
PANSA	4.23	0.13	0.61	0.19	0.93	3.94
NAVIAIR	3.57	0.19	0.58	0.22	0.98	3.50
NAV Portugal (Continental)	4.90	0.15	0.39	0.08	0.61	3.01
M-NAV	4.74	0.09	0.48	0.04	0.61	2.89
Albcontrol	5.58	0.06	0.38	0.08	0.52	2.88
LFV	2.90	0.22	0.52	0.25	0.98	2.85
DCAC Cyprus	4.04	0.15	0.40	0.15	0.70	2.81
HCAA	3.96	0.13	0.41	0.12	0.66	2.61
IAA	4.32	0.09	0.28	0.19	0.57	2.45
LGS	3.05	0.09	0.51	0.18	0.78	2.39
EANS	3.50	0.15	0.32	0.21	0.68	2.38
Oro Navigacija	2.72	0.08	0.49	0.18	0.75	2.05
Avinor (Continental)	2.15	0.25	0.44	0.25	0.95	2.04
Finavia	1.71	0.27	0.38	0.36	1.01	1.72
MATS	2.37	0.04	0.29	0.22	0.55	1.30
UKSATSE	1.59	0.10	0.37	0.13	0.60	0.95
ARMATS	1.20	0.10	0.27	0.21	0.59	0.71
MoldATSA	0.69	0.10	0.41	0.17	0.68	0.47
Pan-European System average	8.25	0.19	0.47	0.19	0.84	6.92

Annex 6 - Table 0.1: Traffic complexity indicators at ANSP level, 2016

ANSPs	ACC name	[1] Adjusted density	[2] Vertical interactions	[3] Horizontal interactions	[4] Speed interactions	[5] = [2]+[3]+[4] Structural complexity	[6] = [1]x[5] Aggregated complexity score	Average used flight level
NATS (Continental)	London TC	26.2	0.5	0.5	0.3	1.3	35.2	148
DHMI	Istanbul	22.2	0.3	0.4	0.2	0.9	19.5	161
DFS	Langen	9.6	0.4	0.6	0.4	1.4	13.2	171
Skyguide	Geneva	12.2	0.2	0.6	0.2	1.0	12.2	315
Skyguide	Zurich	10.0	0.3	0.6	0.2	1.1	11.5	289
DFS	Karlsruhe UAC	11.9	0.2	0.6	0.2	1.0	11.4	354
MUAC	Maastricht	11.0	0.3	0.6	0.2	1.0	10.8	345
Belgocontrol	Brussels	7.6	0.4	0.6	0.4	1.4	10.6	180
LVNL	Amsterdam	10.4	0.2	0.4	0.4	1.0	10.5	168
DSNA	Reims	12.3	0.2	0.5	0.1	0.8	9.8	340
DFS	Munchen	7.2	0.4	0.5	0.4	1.3	9.7	218
DSNA	Paris	10.4	0.3	0.4	0.3	0.9	9.7	226
ENAV	Padova	8.3	0.2	0.7	0.1	1.1	9.0	323
NATS (Continental)	London AC	9.2	0.3	0.4	0.3	1.0	8.8	315
ANS CR	Praha	10.8	0.1	0.5	0.2	0.8	8.8	337
IAA	Dublin	7.9	0.3	0.4	0.4	1.1	8.6	158
ENAV	Milano	7.0	0.3	0.6	0.2	1.1	7.9	284
Austro Control	Wien	8.4	0.1	0.6	0.2	0.9	7.6	334
Slovenia Control	Ljubljana	9.4	0.1	0.6	0.1	0.8	7.6	330
DSNA	Bordeaux	12.5	0.1	0.4	0.1	0.6	7.4	340
DSNA	Brest	11.5	0.1	0.5	0.1	0.6	7.1	353
ENAIRe	Palma	7.5	0.2	0.4	0.3	0.9	6.9	164
LPS	Bratislava	8.9	0.1	0.5	0.2	0.7	6.7	338
HungaroControl	Budapest	8.6	0.1	0.5	0.2	0.7	6.3	345
DSNA	Marseille	9.0	0.1	0.4	0.1	0.7	6.3	327
SMATSA	Beograd	9.3	0.0	0.6	0.1	0.7	6.2	351
Croatia Control	Zagreb	8.1	0.1	0.6	0.1	0.7	5.9	353
NATS (Continental)	Prestwick	4.5	0.3	0.5	0.4	1.2	5.5	262
DFS	Bremen	4.2	0.3	0.6	0.4	1.3	5.3	182
DHMI	Ankara	9.8	0.1	0.2	0.2	0.5	5.3	345
ENAIRe	Barcelona	7.5	0.2	0.4	0.1	0.7	5.3	311
BULATSA	Sofia	8.9	0.1	0.4	0.1	0.6	5.0	353
Sakaeronavigatsia	Tbilisi	6.9	0.0	0.3	0.3	0.7	4.6	341
ENAIRe	Madrid	8.8	0.1	0.4	0.1	0.5	4.5	343
ROMATSA	Bucuresti	6.8	0.1	0.4	0.2	0.6	4.4	345
ENAV	Roma	4.4	0.3	0.6	0.2	1.0	4.2	299
PANSA	Warszawa	4.4	0.1	0.6	0.2	0.9	3.9	341
NAVIAIR	Kobenhavn	3.4	0.2	0.6	0.2	0.9	3.2	319
ENAIRe	Sevilla	5.1	0.2	0.3	0.1	0.6	3.2	310
NAV Portugal (Continental)	Lisboa	5.0	0.1	0.4	0.1	0.6	3.0	327
Albcontrol	Tirana	5.8	0.1	0.4	0.1	0.5	3.0	346
M-NAV	Skopje	4.9	0.1	0.5	0.0	0.6	2.9	339
LFV	Malmo	3.2	0.2	0.6	0.2	0.9	2.9	326
DCAC Cyprus	Nicosia	4.1	0.1	0.4	0.2	0.7	2.8	306
HCAA	Athinai+Macedonia	4.0	0.1	0.4	0.1	0.6	2.4	328
LGS	Riga	3.1	0.1	0.5	0.2	0.8	2.4	322
ENAV	Brindisi	2.8	0.2	0.6	0.1	0.9	2.4	332
EANS	Tallinn	3.6	0.1	0.3	0.2	0.7	2.4	318
LFV	Stockholm	2.0	0.3	0.4	0.4	1.1	2.1	244
Oro Navigacija	Vilnius	2.7	0.1	0.5	0.2	0.8	2.0	313
ENAIRe	Canarias	3.2	0.2	0.3	0.1	0.6	2.0	284
IAA	Shannon	4.0	0.0	0.3	0.1	0.5	1.8	349
Avinor (Continental)	Oslo-Stavanger	1.9	0.2	0.4	0.2	0.8	1.5	292
Avinor (Continental)	Bodo	1.5	0.2	0.4	0.2	0.9	1.3	265
MATS	Malta	2.1	0.0	0.3	0.2	0.6	1.2	331
UkSATSE	L'viv	1.5	0.0	0.6	0.1	0.7	1.1	346
Finavia	Tampere	1.2	0.3	0.3	0.3	0.9	1.1	264
UkSATSE	Kyiv	1.1	0.2	0.3	0.2	0.7	0.8	315
ARMATS	Yerevan	1.2	0.1	0.3	0.2	0.6	0.7	324
UkSATSE	Odesa	2.1	0.0	0.2	0.0	0.3	0.6	344
MoldATSA	Chisinau	0.7	0.1	0.4	0.2	0.7	0.5	285
UkSATSE	Dnipropetrovsk	0.2	0.5	0.3	0.4	1.2	0.2	265
Pan-European System average		8.4	0.2	0.5	0.2	0.8	6.0	314

Annex 6 - Table 0.2: Traffic complexity indicators at ACC level, 2016

ANSPs	Traffic variability indicators		
	Variability based on three months periods (2016)	Peak month / Average month (2016)	Peak week / Average week (2016)
Albcontrol	1.48	1.56	1.64
ANS CR	1.21	1.23	1.23
ARMATS	1.26	1.37	1.50
Austro Control	1.23	1.24	1.25
Avinor (Continental)	1.07	1.10	1.11
Belgocontrol	1.14	1.16	1.18
BULATSA	1.29	1.32	1.34
Croatia Control	1.45	1.50	1.53
DCAC Cyprus	1.23	1.25	1.28
DFS	1.13	1.15	1.15
DHMI	1.18	1.20	1.21
DSNA	1.20	1.24	1.25
EANS	1.13	1.14	1.17
ENAIRE	1.23	1.26	1.27
ENAV	1.28	1.33	1.34
Finavia	1.02	1.08	1.09
HCAA	1.51	1.58	1.60
HungaroControl	1.31	1.34	1.35
IAA	1.14	1.18	1.19
LFV	1.05	1.11	1.11
LGS	1.14	1.16	1.18
LPS	1.33	1.37	1.39
LVNL	1.11	1.11	1.13
MATS	1.16	1.18	1.24
M-NAV	1.64	1.69	1.72
MoldATSA	1.34	1.39	1.49
MUAC	1.11	1.12	1.14
NATS (Continental)	1.14	1.15	1.15
NAV Portugal (Continental)	1.12	1.14	1.15
NAVIAIR	1.08	1.11	1.15
Oro Navigacija	1.14	1.16	1.19
PANSA	1.20	1.24	1.25
ROMATSA	1.24	1.27	1.29
Sakaeronavigatsia	1.15	1.21	1.23
Skyguide	1.16	1.19	1.20
Slovenia Control	1.39	1.42	1.45
SMATSA	1.42	1.46	1.48
UKSATSE	1.32	1.35	1.35

Annex 6 - Table 0.3: Traffic variability indicators at ANSP level, 2016

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ANNEX 7 – EXCHANGE RATES, INFLATION RATES AND PURCHASING POWER PARITIES (PPPS) 2016 DATA

ANSPs	Countries	2016 Exchange rate (1€ =)	2016 Inflation rate (%)	2016 PPPs	Comments
Albcontrol	Albania	139.0	1.3	60.29	
ANS CR	Czech Republic	27.0	0.6	17.66	
ARMATS	Armenia	528.0	-1.4	264.05	PPPs from IMF database
Austro Control	Austria	1	1.0	1.09	
Avinor (Continental)	Norway	10.0	3.9	13.76	
Belgocontrol	Belgium	1	1.8	1.09	
BULATSA	Bulgaria	2.0	-1.3	0.93	
Croatia Control	Croatia	7.5	-0.6	4.80	
DCAC Cyprus	Cyprus	1	-1.2	0.88	
DFS	Germany	1	0.4	1.06	
DHMI	Turkey	3.3	7.7	1.77	
DSNA	France	1	0.3	1.10	
EANS	Estonia	1	0.8	0.73	
ENAIRE	Spain	1	-0.3	0.90	
ENAV	Italy	1	-0.1	0.98	
Finavia	Finland	1	0.4	1.23	
HCAA	Greece	1	0.0	0.82	
HungaroControl	Hungary	311.0	0.4	183.66	
IAA	Ireland	1	-0.2	1.10	
LFV	Sweden	9.5	1.1	12.33	
LGS	Latvia	1.0	0.1	0.68	
LPS	Slovak Republic	1	-0.5	0.67	
LVNL	Netherlands	1	0.1	1.11	
MATS	Malta	1	0.9	0.81	
M-NAV	F.Y.R. Macedonia	61.3	-0.2	26.54	
MoldATSA	Moldova	21.9	6.4	9.56	PPPs from IMF database
MUAC		1	0.1	1.11	Netherlands' PPPs and inflation rate used for MUAC
NATS (Continental)	United Kingdom	0.8	0.7	0.95	
NAV Portugal (Continental)	Portugal	1	0.6	0.80	
NAVIAIR	Denmark	7.4	0.0	10.00	
Oro Navigacija	Lithuania	1.0	0.7	0.61	
PANSA	Poland	4.4	-0.2	2.43	
ROMATSA	Romania	4.5	-1.1	2.28	
Sakaeronavigatsia	Georgia	2.7	2.1	1.23	PPPs from IMF database
Skyguide	Switzerland	1.1	-0.5	1.67	
Slovenia Control	Slovenia	1	-0.2	0.81	
SMATSA	Serbia and Montenegro	123.0	1.1	56.52	Data for Serbia only since ACE data is provided in Serbian Dinar
UKSATSE	Ukraine	28.3	13.9	9.06	PPPs from IMF database

Annex 7 - Table 0.1: 2016 Exchange rates, inflation rates and PPPs data

Presentation and comparison of historical series of financial data from different countries poses problems, especially when different currencies are involved, and inflation rates differ. There is a danger that time-series comparisons can be distorted by transient variations in exchange rates.

For this reason, the following approach has been adopted in this Report for allowing for inflation and exchange rate variation. The financial elements of performance are assessed, for each year, in national currency. They are then converted to national currency in 2016 prices using national

inflation rates. Finally, for comparison purposes in 2016, all national currencies are converted to Euros using the 2016 exchange rate.

This approach has the virtue that an ANSP's performance time series is not distorted by transient changes in exchange rates over the period. It does mean, however, that the performance figures for any ANSP in a given year prior to 2016 are not the same as the figures in that year's ACE report, and cannot legitimately be compared with another ANSP's figures for the same year. Cross-sectional comparison using the figures in this report is only appropriate for 2016 data.

The exchange rates used in this Report to convert the 2016 data in Euros are those provided by the ANSPs in their ACE data submission.

The historical inflation figures used in this analysis were obtained from EUROSTAT³⁹ or from the International Monetary Fund⁴⁰ when the information was not available in EUROSTAT website. For the projections (2017-2021), the ANSPs' own assumptions concerning inflation rates were used.

Purchasing Power Parities (PPPs) are currency conversion rates that are applied to convert economic indicators in national currency to an artificial common currency (Purchasing Power Standard (PPS) for EUROSTAT statistics). The PPPs data used to adjust most of the ANSPs employment costs in Chapter 2 of this report was extracted from EUROSTAT.

For four countries (Armenia, Georgia, Moldova and Ukraine), PPP data was not available in the EUROSTAT database. In these cases, the IMF database was used. Since in the IMF database, the PPPs are expressed in local currency per **international Dollar** rather than **PPS**, an adjustment has been made so that the figures used for Armenia, Georgia, MoldATSA and UksATSE are as consistent as possible with the data used for the rest of the ANSPs. The assumption underlying this adjustment is that the difference in PPPs between two countries shall be the same in the EUROSTAT and in the IMF databases.

According to the IMF database, there is a factor of 8.28 between the PPPs for Ukraine (6.745 UAH per international Dollar in 2016) and the PPPs for France (0.815 Euro per international Dollar). This factor is applied to the PPPs for France as disclosed in the EUROSTAT database (i.e. 1.10) to express the PPPs for Ukraine in PPS ($9.06 = 1.10 \times 8.28$). A similar methodology is used to express Armenia, Georgia and Moldova PPPs in PPS.

³⁹ Latest EUROSTAT database available at:

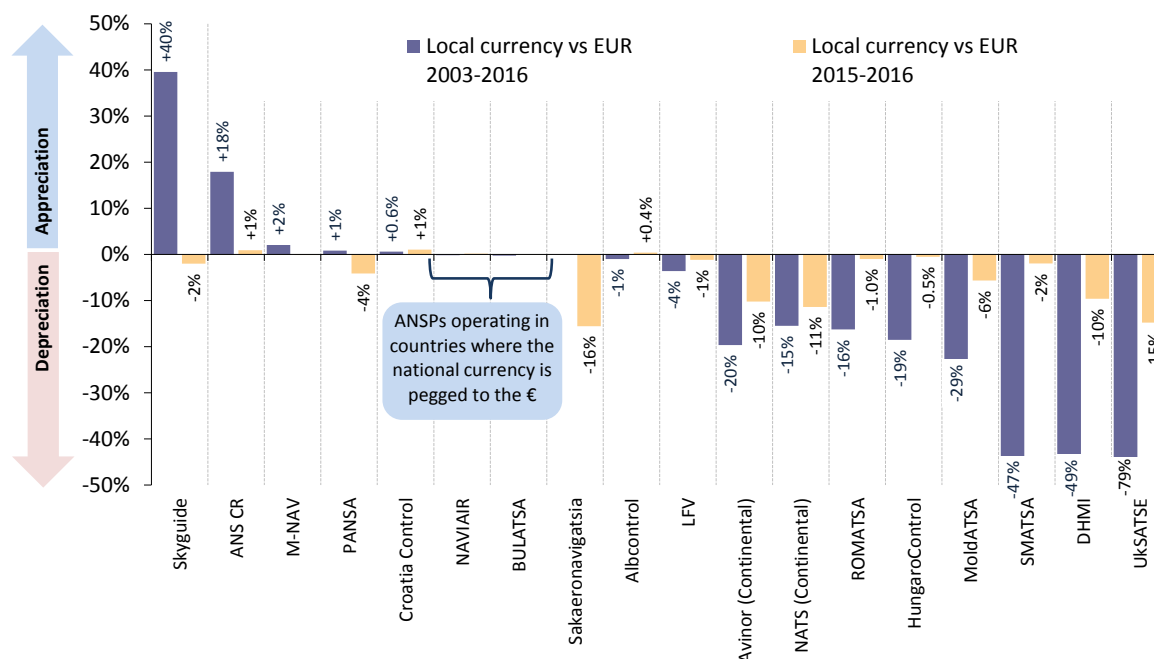
<http://ec.europa.eu/eurostat/web/main/home>

⁴⁰ IMF April 2018 database available at:

<https://www.imf.org/external/pubs/ft/weo/2018/01/weodata/index.aspx>

It is important to note that, for ANSPs operating outside of the Euro zone, substantial changes of the national currency against the Euro may significantly affect the level of 2016 unit ATM/CNS provision costs when expressed in Euro (see Figure 2.12 on p.21). However, it should be noted that the changes in unit costs analysed in this Report (see for example Figure 2.15 on p.24) are not affected by changes in national currency against the Euro.

The Figure below shows the changes in exchange rates for ANSPs operating in countries which are not part of the Euro zone. The blue bar shows the long-term changes in exchange rate over the 2003-2016 period, while the orange bar displays the short-term changes (2015-2016).



Annex 7 - Table 0.2: Cumulative variations in exchange rates against the Euro (2003-2016 and 2015-2016)

Significant changes are observed over the 2003-2016 period for several ANSPs part of the ACE analysis. For example, the Swiss Franc significantly appreciated (40%) while the Ukrainian Hryvnia substantially depreciated (79%). Other substantial variations in exchange rates compared to the Euro include the depreciation of the Serbian Dinar (47%) and the Turkish Lira (49%) while the Czech Koruna appreciated by 18%.

Similarly, changes in exchange rates are also observed over the period 2015-2016 including significant depreciation vis-à-vis the Euro was observed for the Georgian Lari (16%), the Ukrainian Hryvnia (15%) and the British Pound (11%).

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ANNEX 8 – KEY DATA

ANSPs	En-route ANS revenues (in €'000)										Terminal ANS revenues (in €'000)										Gate-to-gate ANS revenues (in €'000)										
	Income from charges	Income for airport operator	Income received from other States for delegation of ANS	Income from the military	Income in respect of exempted flights	Other income from domestic government	Financial income	Other income	Exceptional revenue item	Total revenues	Income from charges	Income for airport operator	Income received from other States for delegation of ANS	Income from the military	Income in respect of exempted flights	Other income from domestic government	Financial income	Other income	Exceptional revenue item	Total revenues	Income from charges	Income for airport operator	Income received from other States for delegation of ANS	Income from the military	Income in respect of exempted flights	Other income from domestic government	Financial income	Other income	Exceptional revenue item	Total revenues	
Albcontrol	21 802	0	0	0	0	0	0	0	0	21 802	1 947	0	0	0	0	0	0	40	0	1 987	23 749	0	0	0	0	0	0	0	40	0	23 789
ANS CR	115 812	0	0	0	2 169	0	0	0	0	117 981	20 296	0	0	0	455	0	0	0	0	20 751	136 108	0	0	0	2 624	0	0	0	0	0	138 732
ARMATS	4 425	0	0	0	4	0	0	0	0	4 429	4 394	0	0	0	0	0	0	0	0	4 394	8 819	0	0	0	4	0	0	0	0	0	8 823
Austro Control	202 509	0	0	0	960	1 335	619	0	0	205 423	40 068	0	0	0	0	191	0	0	0	40 259	242 577	0	0	0	960	1 335	810	0	0	0	245 682
Avinor (Continental)	88 673	0	0	0	0	0	0	0	0	88 673	0	89 615	0	0	0	0	0	0	0	89 615	88 673	89 615	0	0	0	0	0	0	0	0	178 289
Belgocontrol	155 086	0	0	0	0	0	92	4 807	172	160 158	26 273	0	0	0	0	24 916	38	5 381	227	56 835	181 359	0	0	0	0	24 916	130	10 188	399	216 992	
BULATSA	91 102	0	0	0	0	0	0	0	0	91 102	10 762	0	0	0	0	163	233	0	0	11 158	101 864	0	0	0	0	0	163	233	0	102 260	
Croatia Control	78 506	0	6 695	0	210	0	0	0	0	85 411	11 147	0	0	0	174	0	0	0	0	11 322	89 653	0	6 695	0	384	0	0	0	0	0	96 732
DCAC Cyprus	51 189	0	0	0	0	0	0	0	0	51 189	0	0	0	0	0	6 938	0	0	0	6 938	51 189	0	0	0	0	0	6 938	0	0	0	58 127
DFS	899 312	0	0	0	0	0	70 063	0	0	969 374	211 488	0	0	0	0	16 476	0	0	0	227 964	1 110 800	0	0	0	0	0	86 539	0	0	0	1 197 339
DHMI	354 935	0	0	0	3 923	0	0	0	0	358 859	109 842	0	0	0	0	0	0	0	0	109 842	464 777	0	0	0	3 923	0	0	0	0	0	468 700
DSNA	1 330 109	0	0	0	18 055	0	0	11 084	0	1 359 248	237 606	0	0	0	37 824	0	0	2 761	0	278 191	1 567 715	0	0	0	55 878	0	0	13 845	0	0	1 637 439
EANS	25 603	0	0	0	0	0	0	0	0	25 603	1 434	0	0	0	0	0	0	0	0	1 434	27 037	0	0	0	0	0	0	0	0	0	27 037
ENAIRES	739 387	0	0	0	8 267	0	837	12 907	564	761 962	20 953	145 441	0	0	0	185	4 549	5 340	0	176 468	760 340	145 441	0	0	8 267	0	1 022	17 457	5 904	938 430	
ENAV	583 297	0	0	0	10 856	16 221	0	8 645	0	619 019	178 513	0	0	0	1 374	8 179	0	3 986	0	192 053	761 810	0	0	0	12 230	24 400	0	12 632	0	811 071	
Finavia	42 670	0	0	296	0	456	0	0	0	43 422	17 813	0	0	116	0	182	0	224	0	18 335	60 482	0	0	412	0	638	0	224	0	61 756	
HCAA	175 138	0	0	0	0	0	0	0	0	175 138	19 057	0	0	0	0	3 743	0	0	0	22 800	194 195	0	0	0	0	3 743	0	0	0	0	197 938
HungaroControl	100 631	0	0	0	1 093	0	2 015	1 903	0	105 643	18 751	0	0	0	59	0	370	306	0	19 486	119 383	0	0	0	1 152	0	2 384	2 210	0	125 129	
IAA	122 413	0	0	0	1 691	0	21	0	0	124 125	24 674	0	0	0	0	139	0	0	0	24 813	147 087	0	0	0	1 691	0	160	0	0	148 938	
LFV	163 054	0	1 267	0	783	0	683	0	0	165 787	12 943	10 232	0	0	0	0	44	0	0	23 219	175 997	10 232	1 267	0	783	0	727	0	0	189 006	
LGS	21 404	0	0	0	0	0	0	371	0	21 775	2 846	0	0	0	0	0	155	0	0	3 001	24 250	0	0	0	0	0	0	526	0	24 776	
LPS	58 832	0	0	705	1 129	0	21	1 041	0	61 728	3 861	0	0	0	229	0	1	159	0	4 250	62 693	0	0	705	1 358	0	22	1 200	0	65 978	
LVNL	147 577	0	0	0	558	0	0	3 340	0	151 475	61 315	0	0	0	0	0	0	6 679	0	67 994	208 892	0	0	0	558	0	0	10 019	0	219 469	
MATS	22 251	0	0	0	0	0	0	0	0	22 251	5 506	1 221	0	0	1 863	0	0	0	0	8 591	27 756	1 221	0	0	1 863	0	0	0	0	30 841	
M-NAV	11 061	0	0	0	0	0	18	0	0	11 079	1 761	0	0	0	0	0	0	0	0	1 761	12 822	0	0	0	0	0	18	0	0	12 840	
MoldATSA	3 375	0	0	0	0	0	0	0	410	3 785	3 464	0	0	0	0	0	0	0	410	3 874	6 839	0	0	0	0	0	0	0	820	7 658	
MUAC											n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl											
NATS (Continental)	713 236	0	0	0	0	0	1 586	2 027	7 335	724 183	15 188	175 151	0	0	0	0	422	178	8 791	199 731	728 424	175 151	0	0	0	0	2 009	2 205	16 126	923 915	
NAV Portugal (Continental)	140 244	0	0	0	0	0	0	1 762	0	142 006	26 061	0	0	0	0	0	0	2 364	0	28 425	166 305	0	0	0	0	0	0	4 127	0	170 431	
NAVIAIR	82 771	0	0	0	1 806	0	255	1 587	0	86 418	26 398	3 337	0	0	75	0	114	173	0	30 097	109 169	3 337	0	0	1 881	0	368	1 760	0	116 515	
Oro navigacija	22 790	0	0	185	0	0	26	147	381	23 529	5 135	0	0	44	0	0	6	35	92	5 312	27 925	0	0	229	0	0	32	182	473	28 841	
PANSA	139 150	0	0	0	995	0	381	961	0	141 487	31 659	0	0	0	611	0	6	322	0	32 599	170 809	0	0	0	1 606	0	387	1 283	0	174 085	
ROMATSA	159 061	0	0	0	2 040	0	5 632	562	0	167 295	23 318	0	0	0	0	0	608	51	0	23 978	182 380	0	0	0	2 040	0	6 240	613	0	191 273	
Sakaeronavigatsia	17 374	0	0	0	245	0	1 673	0	0	19 293	7 176	0	0	0	91	0	722	334	0	8 323	24 550	0	0	0	336	0	2 395	334	0	27 615	
Skyguide	155 468	0	43 406	0	6 935	38 694	660	1 940	0	247 102	91 111	0	0	0	263	25 818	0	5 128	0	122 320	246 579	0	43 406	0	7 198	64 512	660	7 067	0	369 422	
Slovenia Control	32 697	0	0	0	110	0	0	305	4	33 117	3 051	101	0	459	63	0	88	1 059	4 822	35 749	101	0	459	173	0	0	394	1 063	37 939		
SMATSA	64 137	0	6 587	0	0	0	717	7	0	71 448	7 367	0	0	0	0	196	0	3 715	11 279	71 504	0	6 587	0	0	0	0	913	7	3 715	82 727	
UKSATSE	45 954	0	0	0	0	0	0	0	0	45 954	30 190	0	0	0	0	0	0	0	0	30 190	76 144	0	0	0	0	0	0	0	0	76 144	

Annex 8 - Table 0.1: Breakdown of total ANS revenues (en-route, terminal and gate-to-gate), 2016

ANSPs	Gate-to-gate ANSP costs (in €'000)							
	ATM/CNS provision costs	MET costs	Payment for regulatory and supervision services	Payment to the State for provision of other services	EUROCONTROL costs	Payment for delegation	Irrecoverable value added tax (VAT)	Total costs
Albcontrol	22 029	508	1 165	0	939	0	0	24 641
ANS CR	123 731	2 664	1 621	0	5 650	0	0	133 666
ARMATS	8 269	0	0	0	295	0	0	8 564
Austro Control	195 879	18 539	799	0	11 602	0	0	226 819
Avinor (Continental)	160 585	2 167	1 533	0	7 405	0	0	171 689
Belgocontrol	147 084	9 962	2 164	0	9 713	38 687	0	207 610
BULATSA	89 691	6 318	14	0	3 644	0	0	99 668
Croatia Control	84 671	6 005	0	0	0	0	0	90 676
DCAC Cyprus	38 699	4 159	544	11 007	2 449	0	0	56 858
DFS	1 092 373	0	729	0	0	0	0	1 093 101
DHMI	467 058	25 775	2 640	0	21 783	0	0	517 257
DSNA	1 253 962	86 605	7 110	0	77 554	50 238	54 211	1 529 680
EANS	18 117	243	0	0	0	0	0	18 360
ENAIRe	757 539	25 632	8 374	0	44 304	0	0	835 850
ENAV	684 317	24 608	4 149	0	41 098	0	0	754 171
Finavia	63 853	4 209	394	0	0	387	0	68 844
HCAA	146 099	8 080	1 030	0	8 802	0	0	164 011
HungaroControl	97 820	3 239	1 871	0	4 211	0	0	107 141
IAA	110 715	9 497	2 071	3 027	6 569	0	0	131 879
LFV	180 009	1 937	396	0	0	0	0	182 342
LGS	22 400	1 088	1 149	0	1 054	0	0	25 691
LPS	59 407	3 161	1 444	0	3 074	0	0	67 086
LVNL	182 594	0	0	0	0	0	11 273	193 867
MATS	17 926	745	1 140	0	772	0	0	20 583
M-NAV	11 771	926	168	0	0	0	0	12 865
MoldATSA	7 790	1 136	0	0	285	0	0	9 211
MUAC	143 246	0	0	0	0	0	11	143 257
NATS (Continental)	800 160	1 424	8 608	0	0	763	65	811 020
NAV Portugal (Continental)	117 264	6 566	1 090	4 754	6 908	0	0	136 583
NAVIAIR	111 502	0	0	0	0	0	0	111 502
Oro navigacija	25 709	726	379	0	1 147	0	0	27 961
PANSA	158 687	9 167	2 261	0	9 806	883	0	180 805
ROMATSA	172 782	9 749	2 260	0	7 562	0	0	192 353
Sakaeronavigatsia	23 104	605	159	0	736	0	0	24 604
Skyguide	317 091	15 204	1 848	0	9 763	0	0	343 905
Slovenia Control	32 307	2 307	796	0	1 558	0	0	36 968
SMATSA	73 239	4 530	0	0	2 824	0	0	80 593
UKSATSE	72 467	1 070	751	0	6 288	0	0	80 577
Total	8 091 946	298 553	58 659	18 789	297 796	90 959	65 560	8 922 261

Annex 8 - Table 0.2: Breakdown of total gate-to-gate ANSP costs, 2016

ANSPs	En-route ATM/CNS costs (in €'000)						Terminal ATM/CNS costs (in €'000)						Gate-to-gate ATM/CNS costs (in €'000)					
	Staff costs	Non-staff operating costs	Depreciation costs	Cost of capital	Exceptional items	ATM/CNS provision costs	Staff costs	Non-staff operating costs	Depreciation costs	Cost of capital	Exceptional items	ATM/CNS provision costs	Staff costs	Non-staff operating costs	Depreciation costs	Cost of capital	Exceptional items	ATM/CNS provision costs
Albcontrol	6 432	5 960	5 023	1 902	0	19 318	1 542	615	380	174	0	2 711	7 974	6 575	5 403	2 077	0	22 029
ANS CR	62 967	14 660	14 825	8 740	0	101 191	14 956	2 822	3 118	1 644	0	22 539	77 923	17 482	17 943	10 384	0	123 731
ARMATS	2 225	681	686	865	0	4 457	1 979	601	550	682	0	3 812	4 204	1 282	1 236	1 547	0	8 269
Austro Control	116 457	17 512	18 681	4 664	2 823	160 137	26 383	4 210	4 566	583	0	35 742	142 840	21 722	23 247	5 247	2 823	195 879
Avinor (Continental)	50 465	13 398	5 956	5 626	0	75 444	70 181	12 728	1 019	1 214	0	85 141	120 646	26 126	6 974	6 839	0	160 585
Belgocontrol	67 180	14 089	9 166	3 654	6	94 095	39 536	8 202	4 161	1 090	0	52 989	106 716	22 290	13 328	4 744	6	147 084
BULATSA	55 609	8 618	7 401	9 581	0	81 209	6 165	814	757	748	0	8 483	61 773	9 431	8 158	10 329	0	89 691
Croatia Control	47 120	14 336	12 080	1 649	0	75 185	5 989	1 762	1 446	290	0	9 486	53 109	16 097	13 526	1 939	0	84 671
DCAC Cyprus	13 590	13 443	4 352	3 500	0	34 885	1 666	1 287	571	290	0	3 814	15 256	14 730	4 923	3 790	0	38 699
DFS	602 564	60 614	80 368	73 889	39 089	856 525	169 036	20 283	16 419	18 742	11 369	235 848	771 600	80 897	96 787	92 630	50 458	1 092 373
DHMI	169 561	117 791	44 621	34 581	0	366 554	40 718	31 051	15 696	13 039	0	100 504	210 279	148 842	60 317	47 620	0	467 058
DSNA	672 178	200 752	103 494	35 267	0	1 011 691	169 838	45 319	19 918	7 197	0	242 272	842 016	246 070	123 412	42 464	0	1 253 962
ENAS	10 016	2 411	2 069	1 884	0	16 379	379	545	577	237	0	1 738	10 394	2 956	2 647	2 120	0	18 117
ENAIRES	395 610	63 044	83 182	37 408	6 416	585 659	133 248	12 122	17 790	7 203	1 517	171 880	528 858	75 166	100 972	44 611	7 933	757 539
ENAV	288 532	103 446	92 587	55 380	0	539 944	70 077	36 474	26 123	11 700	0	144 373	358 608	139 919	118 710	67 079	0	684 317
Finavia	19 763	13 525	4 427	1 857	0	39 572	14 729	6 483	2 131	938	0	24 281	34 492	20 008	6 558	2 795	0	63 853
HCAA	101 774	18 730	2 728	1 102	0	124 334	16 020	5 253	365	128	0	21 765	117 794	23 982	3 093	1 230	0	146 099
HungaroControl	42 706	25 506	10 191	3 918	231	82 552	9 196	3 717	1 841	513	0	15 268	51 902	29 224	12 032	4 431	231	97 820
IAA	54 866	20 377	8 713	6 096	0	90 052	9 318	4 744	3 850	2 751	0	20 663	64 184	25 121	12 563	8 847	0	110 715
LFV	111 127	24 041	14 391	3 629	0	153 188	24 244	2 521	43	13	0	26 820	135 371	26 562	14 433	3 643	0	180 009
LGS	10 717	2 412	3 179	1 022	0	17 330	2 855	415	1 542	258	0	5 070	13 572	2 827	4 721	1 280	0	22 400
LPS	33 893	8 789	7 265	2 789	0	52 736	4 738	1 008	565	360	0	6 671	38 631	9 797	7 830	3 149	0	59 407
LVNL	96 988	21 024	7 047	900	0	125 959	43 650	9 461	3 171	353	0	56 635	140 638	30 485	10 218	1 253	0	182 594
MATS	7 057	4 466	2 408	882	0	14 813	1 762	552	602	198	0	3 113	8 818	5 018	3 010	1 080	0	17 926
M-NAV	8 076	1 685	600	243	0	10 605	918	172	55	21	0	1 166	8 993	1 858	656	264	0	11 771
MoldATSA	1 438	648	538	618	384	3 627	1 474	1 077	448	718	446	4 163	2 912	1 725	986	1 335	831	7 790
MUAC	119 137	15 575	8 174	360	0	143 246	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	119 137	15 575	8 174	360	0	143 246
NATS (Continental)	334 531	91 161	142 593	63 623	821	632 729	118 910	43 027	3 620	1 813	61	167 431	453 441	134 188	146 214	65 436	882	800 160
NAV Portugal (Continental)	76 714	9 501	4 806	2 555	0	93 576	20 295	1 428	1 492	474	0	23 688	97 009	10 929	6 298	3 029	0	117 264
NAVIAIR	51 362	13 166	10 184	6 270	0	80 983	21 363	4 744	1 620	2 793	0	30 519	72 725	17 911	11 804	9 063	0	111 502
Oro navigacija	12 945	4 850	2 152	748	0	20 695	2 688	1 110	985	231	0	5 014	15 633	5 960	3 137	979	0	25 709
PANSA	91 728	16 728	13 035	11 087	0	132 577	18 096	3 725	2 319	1 970	0	26 109	109 823	20 453	15 354	13 057	0	158 687
ROMATSA	99 743	18 440	6 834	9 150	9 279	143 446	19 758	4 379	1 716	2 456	1 027	29 336	119 500	22 819	8 551	11 606	10 306	172 782
Sakaeronavigatsia	7 119	3 321	3 692	1 800	673	16 605	2 874	1 060	1 253	1 084	228	6 499	9 993	4 381	4 945	2 884	901	23 104
Skyguide	146 138	14 971	29 227	5 421	4 269	200 026	83 365	14 579	14 249	2 790	2 081	117 065	229 503	29 550	43 476	8 211	6 350	317 091
Slovenia Control	19 264	4 150	3 358	1 613	303	28 689	2 920	432	164	79	24	3 618	22 184	4 582	3 522	1 691	328	32 307
SMATSA	33 976	11 784	7 828	3 820	122	57 529	8 948	3 104	2 130	1 496	33	15 711	42 924	14 887	9 957	5 315	155	73 239
UKSATSE	33 193	7 347	6 154	7 650	421	54 763	10 769	2 335	2 013	2 446	140	17 704	43 962	9 682	8 167	10 095	561	72 467
Total	4 074 759	1 002 951	784 014	415 742	64 836	6 342 302	1 190 580	294 157	159 266	88 713	16 928	1 749 643	5 265 338	1 297 108	943 281	504 455	81 764	8 091 946

Annex 8 - Table 0.3: Breakdown of ATM/CNS provision costs⁴¹ (en-route, terminal and gate-to-gate), 2016

⁴¹ ENAIRES 2016 ATM/CNS provision costs comprise costs relating to ATM/CNS infrastructure shared with the military authority (€16.6M), which are charged to civil airspace users. It should be noted that these costs, which are borne by the Spanish Air Force (Ministry of Defence), as well as the corresponding revenues, are not passing through ENAIRES Accounts from 2014 onwards.

ANSPs	ANSP BALANCE SHEET in (€'000)								
	NBV fixed assets in operation	NBV fixed assets under construction	Long-term financial assets and receivables	Current assets	Total assets	Capital and reserves	Long-term liabilities	Current liabilities	Total liabilities
Albcontrol	37 480	3 295	36	15 634	56 445	43 805	9 590	3 050	56 445
ANS CR	106 606	33 426	10 395	91 571	241 997	212 594	4 301	25 102	241 997
ARMATS	10 762	1	29	3 274	14 065	12 332	938	795	14 064
Austro Control	217 295	10 149	92 527	165 669	485 640	85 700	359 632	40 308	485 640
Avinor (Continental)	67 421	43 966	20 562	98 042	229 991	70 522	93 685	65 784	229 991
Belgocontrol	90 367	5 199	90	150 694	246 350	187 958	16 622	41 771	246 350
BULATSA	95 126	12 101	13 160	101 065	221 453	161 972	26 461	33 020	221 453
Croatia Control	59 269	6 236	2 343	75 844	143 691	78 386	43 886	21 420	143 692
DCAC Cyprus	14 908	1 242	0	17 296	33 446	10 384	23 062	0	33 446
DFS	703 648	19 486	75 953	2 010 075	2 809 162	957 406	1 613 415	238 340	2 809 162
DHMI	774 693	48 413	11	176 838	999 955	928 560	23 357	48 038	999 955
DSNA	611 513	250 106	5 339	0	866 957	317 133	549 824	0	866 957
EANS	16 669	5 154	0	7 409	29 231	18 382	4 961	5 888	29 231
ENAIRE	450 816	125 551	65 405	533 947	1 175 719	825 391	216 830	133 498	1 175 719
ENAV	842 259	290 527	336 805	561 169	2 030 760	1 142 863	477 861	410 036	2 030 760
Finavia	38 403	4 095	0	12 000	54 498	32 645	21 854	0	54 498
HCAA	7 284	6 552	0	0	13 836	13 836	0	0	13 836
HungaroControl	64 213	1 929	1 590	104 485	172 217	141 897	6 839	23 481	172 217
IAA	53 709	26 170	14 573	251 308	345 760	127 187	188 924	29 649	345 760
LFV	93 611	20 258	106 618	579 508	799 996	84 789	647 272	67 934	799 996
LGS	15 326	6 495	0	9 466	31 287	28 422	316	2 549	31 287
LPS	46 296	3 070	20	48 638	98 024	68 838	11 161	18 025	98 024
LVNL	90 177	43 185	0	74 700	208 062	70 960	87 964	49 138	208 062
MATS	10 201	249	9 500	19 929	39 878	33 590	3 983	2 306	39 878
M-NAV	5 780	1 298	0	9 272	16 350	14 710	605	1 035	16 350
MoldATSA	5 651	7	10	4 729	10 397	9 821	0	576	10 397
MUAC	57 150	7 594	0	45 443	110 186	0	64 743	45 443	110 186
NATS (Continental)	977 021	231 956	383 324	635 564	2 227 864	18 609	1 926 287	282 968	2 227 864
NAV Portugal (Continental)	58 216	16 686	58 385	167 209	300 495	103 408	132 149	64 938	300 495
NAVIAIR	135 517	16 962	10 153	49 454	212 086	129 353	48 607	34 127	212 086
Oro navigacija	20 878	8 935	3 000	18 532	51 345	46 120	3 101	2 124	51 345
PANSA	181 917	22 102	15 450	109 240	328 709	170 344	114 385	43 980	328 709
ROMATSA	85 856	19 831	30 382	149 345	285 415	148 604	118 393	18 418	285 415
Sakaeronavigatsia	32 701	9 174	6 230	12 669	60 773	54 022	2 489	4 263	60 773
Skyguide	299 190	62 311	25 834	227 326	614 661	337 983	200 878	75 800	614 661
Slovenia Control	29 288	251	235	5 716	35 491	17 210	9 666	8 616	35 491
SMATSA	99 993	5 044	0	36 310	141 347	103 926	17 861	19 560	141 347
UKSATSE	89 210	23 127	1 225	74 925	188 486	181 854	1 304	5 329	188 486
Total	6 596 417	1 392 132	1 289 183	6 654 294	15 932 026	6 991 513	7 073 206	1 867 306	15 932 026

Annex 8 - Table 0.4: Balance Sheet data at ANSP level, 2016

ANSPs	ATCOs in OPS	ATCOs on other duties	Ab-initio trainees	On-the-job trainees	ATC assistants	OPS support (non-ATCO)	Technical support staff for operational maintenance	Technical support staff for planning & development	Administration	Staff for ancillary services	Internal MET	Other	Total staff	ACC ATCOs in OPS	ACC ATCO-hours on duty	APPs+TWRs ATCOs in OPS	APPs+TWRs ATCO-hours on duty	Employment costs for ATCOs in OPS (€'000)
Albcontrol	67	7	0	0	7	0	89	0	72	22	16	52	332	35	50 190	32	46 176	2 786
ANS CR	190	19	16	13	100	72	132	25	230	31	0	71	899	92	138 092	98	149 450	28 913
ARMATS	80	0	0	7	6	22	128	0	45	26	0	68	382	24	32 400	56	76 496	1 311
Austro Control	295	18	12	15	41	81	98	106	70	32	89	0	856	124	163 432	171	238 203	63 144
Avinor (Continental)	403	113	10	22	107	0	129	80	48	16	0	16	945	129	205 435	273	428 350	52 292
Belgocontrol	225	23	17	3	0	45	148	22	132	30	72	42	759	86	109 736	139	190 151	46 959
BULATSA	264	44	0	3	47	31	308	37	155	43	54	80	1 066	134	171 878	129	167 638	26 294
Croatia Control	246	18	12	17	33	50	110	33	113	41	59	0	732	106	127 624	140	196 980	30 798
DCAC Cyprus	100	10	0	1	37	0	0	0	32	30	0	0	209	73	142 970	27	50 976	9 371
DFS	1 894	120	45	125	307	476	732	662	471	101	0	252	5 186	1 497	1 264 574	397	504 297	397 351
DHMI	1 291	58	72	64	30	394	1 547	22	1 320	438	0	1 078	6 313	581	834 316	710	714 970	97 612
DNA	2 859	317	175	189	109	1 061	1 251	335	1 191	182	0	7 669		1 394	1 789 896	1 465	1 881 576	371 027
EANS	57	19	1	0	5	2	31	0	6	27	0	31	179	27	41 715	30	46 350	5 381
ENAIRE	1 703	263	0	0	154	48	510	313	540	17	0	74	3 622	1 080	1 376 511	623	738 794	344 425
ENAV	1 442	232	0	68	54	21	111	121	568	140	235	178	3 170	835	982 260	606	782 365	212 632
Finavia	182	26	0	0	7	0	50	8	23	38	3	0	337	53	76 002	129	192 855	23 254
HCAA	480	58	0	3	0	48	481	43	110	5	0	405	1 633	208	354 016	272	462 944	41 331
HungaroControl	171	6	22	0	30	29	102	37	188	64	21	88	758	101	157 560	70	108 850	26 799
IAA	211	29	12	6	24	8	45	22	71	0	0	0	428	148	225 996	63	97 020	31 701
LFV	440	84	0	5	47	25	80	34	185	31	2	0	933	200	354 600	240	425 520	82 673
LGS	92	0	0	0	0	41	101	0	91	15	12	1	353	65	85 995	27	32 373	4 481
LPS	89	25	2	6	45	30	119	18	123	31	0	0	486	49	73 255	39	61 245	13 794
LVNL	216	19	20	28	78	161	110	101	170	12	0	66	981	77	118 241	139	290 566	56 655
MATS	52	0	0	0	0	0	41	0	37	16	0	0	146	32	64 544	20	38 960	3 957
M-NAV	68	17	0	0	9	8	46	0	53	29	17	25	272	44	64 204	24	35 112	4 047
MoldATSA	78	15	0	3	0	9	40	12	49	10	32	43	291	41	59 245	37	53 835	1 220
MUAC	267	24	8	0	41	51	123	0	55	0	0	0	569	267	308 977	n/appl	n/appl	66 834
NATS (Continental)	1 338	137	47	9	330	294	797	162	804	0	0	0	3 917	884	1 173 798	453	560 155	229 976
NAV Portugal (Continental)	222	32	0	6	24	53	88	57	160	43	7	3	695	90	160 650	132	240 240	48 067
NAVIAIR	212	65	0	6	88	28	97	30	86	11	0	0	624	94	138 087	118	175 747	32 471
Oro navigacija	82	11	0	3	0	26	66	9	69	28	0	0	292	32	53 083	50	80 673	6 168
PANSA	510	26	52	63	73	277	326	40	330	99	0	0	1 797	143	151 765	366	402 271	53 628
ROMATSA	441	108	40	15	72	0	352	0	389	0	121	0	1 536	213	274 002	228	259 234	52 851
Sakaeronavigatsia	94	8	13	5	14	13	378	5	151	49	55	0	785	33	45 903	61	84 851	2 944
Skyguide	359	61	16	9	87	207	181	116	203	59	0	13	1 310	210	271 845	148	185 383	83 999
Slovenia Control	90	15	0	0	16	4	36	0	36	24	0	0	221	51	72 340	39	55 312	11 117
SMATSA	268	64	0	6	27	31	92	121	111	66	89	0	875	146	170 528	122	142 496	17 242
UKSATSE	812	198	0	1	73	215	1 081	74	592	91	31	1 189	4 357	517	702 086	295	411 820	11 875
Total	17 888	2 290	591	701	2 123	3 860	10 155	2 646	9 078	1 896	914	3 775	55 915	9 917	12 587 751	7 971	10 610 236	2 597 379

Annex 8 - Table 0.5: Total staff and ATCOs in OPS data, 2016

ANSPs	Size of controlled airspace	Number of ACC operational units	Number of APP operational units	Number of TWR operational units	Number of AFIS	Total IFR flights controlled by the ANSP	Total IFR km controlled by the ANSP	Total flight-hours controlled by the ANSP	IFR Airport movements controlled by the ANSP	Composite flight-hours
Albcontrol	36 000	1	1	1	1	186 792	30 978 424	39 398	22 319	45 378
ANS CR	76 300	1	4	4	0	781 615	188 900 276	251 992	149 431	292 029
ARMATS	29 700	1	2	2	2	38 968	7 204 606	10 345	18 502	15 302
Austro Control	80 900	1	6	6	0	918 769	197 364 943	279 848	326 052	367 206
Avinor (Continental)	731 000	3	17	19	28	599 846	203 036 814	365 874	656 193	541 685
Belgocontrol	39 500	1	4	5	0	595 248	56 060 697	108 457	355 777	203 779
BULATSA	145 000	1	3	5	0	757 796	207 976 181	256 423	89 218	280 327
Croatia Control	128 000	1	7	10	0	533 791	158 986 736	205 000	98 304	231 338
DCAC Cyprus	173 000	1	2	2	0	322 214	115 962 089	151 798	70 308	170 635
DFS	390 000	4	16	16	0	2 892 868	917 974 051	1 395 812	2 017 084	1 936 242
DHMI	982 000	2	46	46	0	1 304 601	951 016 833	1 251 491	1 231 835	1 581 532
DSNA	1 010 000	5	12	77	55	3 015 153	1 647 941 888	2 287 512	1 830 245	2 777 883
EANS	77 400	1	2	2	0	199 302	50 711 744	67 869	38 598	78 210
ENAIRE	2 190 000	5	17	22	0	1 867 734	973 345 967	1 391 501	1 407 079	1 768 495
ENAV	732 000	4	25	16	11	1 610 488	717 545 638	1 020 576	1 256 978	1 357 354
Finavia	410 000	1	5	15	9	230 170	62 261 664	105 306	230 050	166 943
HCAA	538 000	1	16	18	15	700 033	358 755 081	482 274	439 082	599 915
HungaroControl	104 200	1	1	1	0	841 648	186 948 688	238 135	95 743	263 787
IAA	457 000	2	3	3	0	610 081	239 863 271	309 697	259 378	379 191
LFV	627 000	2	17	21	0	721 137	287 721 951	427 593	477 146	555 433
LGS	95 900	1	2	1	1	244 283	55 703 380	74 627	67 780	92 787
LPS	48 700	1	2	5	0	497 527	77 034 225	97 738	31 258	106 113
LVNL	53 100	1	3	4	0	612 602	79 422 374	164 006	533 632	306 980
MATS	231 000	1	2	1	1	110 385	56 426 930	78 813	44 502	90 736
M-NAV	24 700	1	2	2	1	145 599	18 949 933	24 265	16 511	28 689
MoldATSA	34 800	1	1	4	0	41 803	6 036 705	9 442	22 410	15 446
MUAC	260 000	1	0	0	0	1 779 969	514 328 378	625 901	n/appl	625 901
NATS (Continental)	880 000	3	16	16	0	2 399 723	884 134 192	1 422 661	1 595 433	1 850 120
NAV Portugal (Continental)	671 000	1	4	6	0	557 791	279 174 460	374 189	346 569	467 044
NAVIAIR	158 000	1	7	6	1	653 451	143 746 973	217 906	352 347	312 309
Oro navigacija	74 700	1	4	4	0	228 750	38 434 173	53 584	53 127	67 818
PANSA	334 000	1	4	15	0	740 246	311 579 950	426 110	354 388	521 060
ROMATSA	254 000	1	3	16	0	620 513	265 222 094	338 782	173 331	385 222
Sakaeronavigatsia	89 300	1	3	3	1	125 729	41 827 957	50 914	29 726	58 878
Skyguide	69 700	2	4	7	0	1 205 751	217 517 446	329 175	488 008	459 925
Slovenia Control	20 400	1	3	3	0	275 251	38 076 948	50 608	30 282	58 721
SMATSA	129 000	1	8	8	0	615 464	185 849 663	236 494	87 448	259 923
UkSATSE	776 000	4	8	17	3	194 561	93 730 898	131 327	132 421	166 806
Total		63	282	409	129		10 867 754 222	15 353 441	15 428 495	19 487 144

Annex 8 - Table 0.6: Operational data at ANSP level, 2016

ANSPs	ACC Code	Flight-hours controlled	ATCO-hours on duty	ATCO-hour productivity	Average transit time in minutes	IFR ACC Movements	Size of the controlled area	ATCOs in OPS	Size of OPS room area (m ²)	Number of sectors open at maximum configuration	Sum of sector-hours
Albcontrol	Tirana	38 179	50 190	0.76	12	186 589	36 000	35	265	4	18 025
ANS CR	Praha	220 441	138 092	1.60	17	767 688	76 300	92	950	9	31 746
ARMATS	Yerevan	7 011	32 400	0.22	12	35 206	29 700	24	168	1	8 760
Austro Control	Wien	204 729	163 432	1.25	16	768 113	79 500	124	900	12	38 400
Avinor (Continental)	Bodo	83 935	60 329	1.39	29	176 098	400 000	38	450	7	31 000
Avinor (Continental)	Oslo	69 485	95 891	0.72	14	290 697	111 000	60	605	6	32 212
Avinor (Continental)	Stavanger	83 119	49 216	1.69	26	189 055	216 000	31	250	7	20 607
Belgocontrol	Brussels	75 094	109 736	0.68	8	587 544	39 500	86	1 054	7	21 463
BULATSA	Sofia	240 611	171 878	1.40	20	735 489	147 000	134	1 183	18	33 408
Croatia Control	Zagreb	182 142	127 624	1.43	22	498 725	128 000	106	800	11	25 302
DCAC Cyprus	Nicosia	141 256	142 970	0.99	26	322 044	173 000	73	250	5	29 000
DFS	Karlsruhe UAC	598 192	384 498	1.56	20	1 789 255	261 000	435	1 850	38	147 339
DFS	Langen	351 941	390 928	0.90	17	1 230 077	108 000	477	1 300	35	142 854
DFS	Munchen	256 429	254 143	1.01	14	1 088 375	119 000	317	1 262	19	105 626
DFS	Bremen	189 250	235 005	0.81	17	650 730	174 000	267	1 050	16	91 711
DHMI	Ankara	976 273	598 812	1.63	46	1 260 117	982 000	417	1 998	20	148 920
DHMI	Istanbul	225 920	235 504	0.96	18	739 969	125 000	164	420	5	35 040
DSNA	Bordeaux	471 397	321 000	1.47	31	916 216	212 000	250	1 295	19	127 910
DSNA	Reims	263 416	308 160	0.85	18	892 948	117 000	240	1 040	17	103 022
DSNA	Paris	422 252	409 596	1.03	21	1 224 426	167 000	319	1 250	20	116 818
DSNA	Marseille	390 729	428 856	0.91	22	1 043 744	298 000	334	1 310	28	147 782
DSNA	Brest	502 883	322 284	1.56	31	979 623	400 000	251	850	18	138 086
EANS	Tallinn	60 437	41 715	1.45	19	193 813	77 400	27	269	3	11 350
ENAIRES	Canarias	170 604	178 484	0.96	33	309 685	1 370 000	139	750	10	47 743
ENAIRES	Barcelona	347 163	371 930	0.93	25	827 454	266 000	292	1 485	20	98 992
ENAIRES	Madrid	541 686	529 407	1.02	32	1 016 272	435 000	410	1 070	26	147 172
ENAIRES	Palma	77 066	137 826	0.56	16	294 351	51 400	112	739	8	39 225
ENAIRES	Sevilla	150 999	158 864	0.95	25	355 837	179 000	127	773	8	42 256
ENAV	Brindisi	86 519	97 616	0.89	19	268 329	136 000	83	550	4	16 726
ENAV	Milano	257 908	297 085	0.87	19	814 660	75 800	249	593	21	72 745
ENAV	Padova	183 063	226 102	0.81	17	664 450	84 000	190	375	13	48 916
ENAV	Roma	417 002	361 457	1.15	32	792 080	437 000	313	1 600	22	91 822
Finavia	Tampere	66 707	76 002	0.88	24	165 187	410 000	53	550	6	17 885
HCAA	Athina+Macedonia	418 009	354 016	1.18	37	669 407	538 000	208	1 000	12	59 400
HungaroControl	Budapest	220 202	157 560	1.40	16	816 874	104 200	101	720	9	32 085
IAA	Dublin	40 705	58 026	0.70	11	232 431	23 200	38	441	4	23 000
IAA	Shannon	249 916	167 970	1.49	34	443 306	449 000	110	576	10	49 200
LFV	Malmo	220 341	205 668	1.07	25	521 618	226 000	116	841	15	45 000
LFV	Stockholm	130 859	148 932	0.88	19	404 114	479 000	84	828	11	46 800
LGS	Riga	74 561	85 995	0.87	18	244 239	95 900	65	169	4	28 835
LPS	Bratislava	92 494	73 255	1.26	11	484 046	48 700	49	813	5	14 885
LVNL	Amsterdam	81 577	118 241	0.69	8	578 862	53 100	77	1 800	5	21 241
MATS	Malta	68 985	64 544	1.07	38	109 184	231 000	32	121	2	17 520
M-NAV	Skopje	22 153	64 204	0.35	10	138 686	24 700	44	202	3	10 100
MoldATSA	Chisinau	7 003	59 245	0.12	11	39 447	34 800	41	144	2	17 520
MUAC	Maastricht	625 901	308 977	2.03	21	1 779 969	260 000	267	1 050	20	76 075
NATS (Continental)	Prestwick	363 219	309 600	1.17	23	952 738	631 000	233	1 020	25	146 812
NATS (Continental)	London AC	549 064	458 672	1.20	17	1 980 492	286 000	346	1 090	23	81 000
NATS (Continental)	London TC	311 715	405 526	0.77	14	1 378 548	49 400	306	987	22	110 000
NAV Portugal (Continental)	Lisboa	316 569	160 650	1.97	36	524 879	671 000	90	663	8	43 715
NAVIAIR	Kobenhavn	160 107	138 087	1.16	17	553 719	158 000	94	600	7	31 208
Oro Navigacija	Vilnius	46 465	53 083	0.88	13	221 576	74 700	32	336	3	19 710
PANSA	Warszawa	333 567	151 765	2.20	29	692 674	331 000	143	1 300	11	42 180
ROMATSA	Bucuresti	313 534	274 002	1.14	31	611 401	254 000	213	1 391	11	55 261
Sakaeronavigatsia	Tbilisi	48 293	45 903	1.05	23	124 319	88 700	33	250	2	17 520
Skyguide	Geneva	112 923	139 945	0.81	11	625 945	30 000	106	1 113	9	29 525
Skyguide	Zurich	134 414	131 900	1.02	11	746 346	39 800	104	960	10	37 012
Slovenia Control	Ljubljana	48 696	72 340	0.67	11	272 604	20 400	51	360	4	14 656
SMATSA	Beograd	219 162	170 528	1.29	22	604 055	129 000	146	744	9	40 041
UkSATSE	Kyiv	55 526	281 106	0.20	29	114 918	185 000	207	883	12	71 292
UkSATSE	Dnipropetrovsk	5 474	168 392	0.03	21	16 016	288 000	124	415	7	42 491
UkSATSE	L'viv	38 154	116 788	0.33	24	94 593	134 000	86	202	5	17 910
UkSATSE	Odesa	30 099	135 800	0.22	25	71 227	170 000	100	235	6	35 090
Total		13 693 524	12 587 751	1.09	22	38 123 079	14 028 200	9 917		739	3 506 946

Annex 8 - Table 0.7: Operational data at ACC level, 2016

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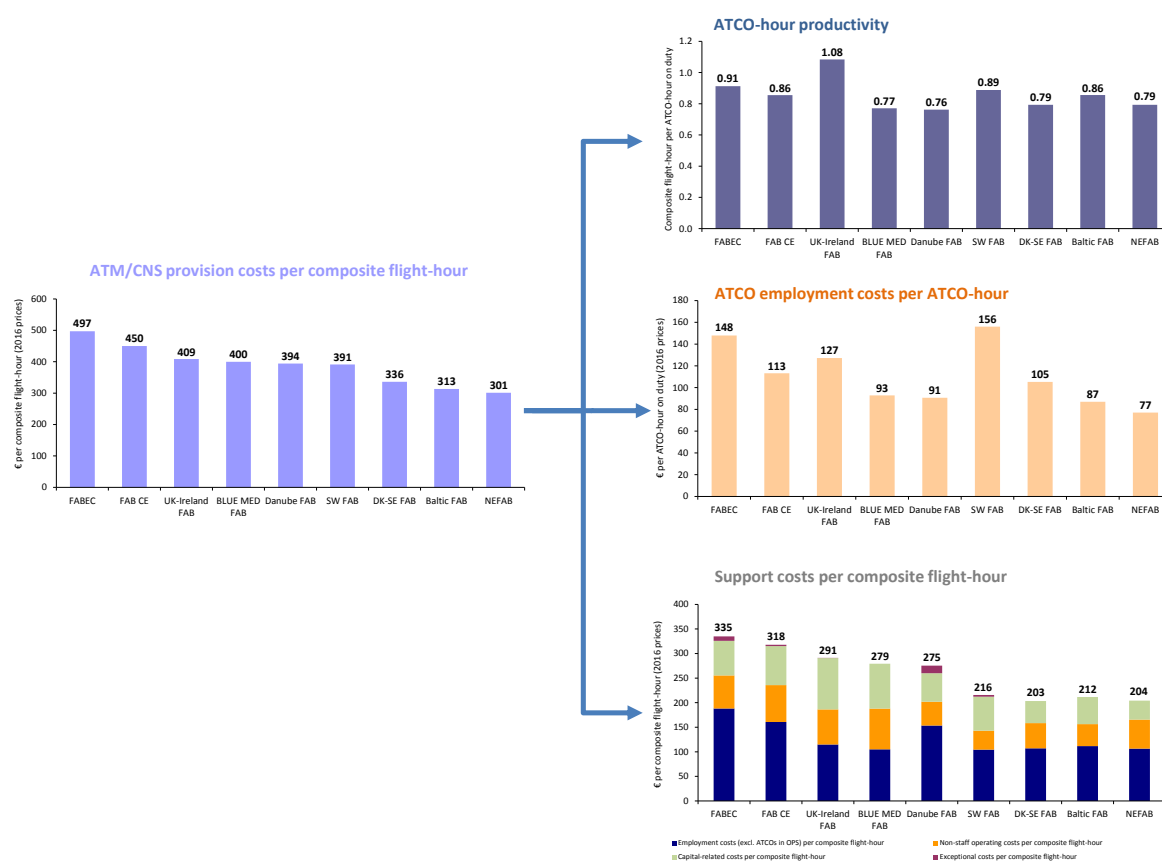
ANNEX 9 – PERFORMANCE INDICATORS AT FAB LEVEL

This Annex provides a breakdown of the **financial** cost-effectiveness indicator at FAB level by ATCO-hour productivity, ATCO employment costs per ATCO-hour and support costs per composite flight-hour.

The figures shown at FAB level have been computed taking into account the ANSPs participating to the ACE analysis in 2016 and which were formally part of a FAB initiative:

- **FABEC**: Belgocontrol, DFS, DSNA, LVNL, MUAC and Skyguide.
- **FAB CE**: ANS CR, Austro Control, Croatia Control, HungaroControl, LPS and Slovenia Control.
- **SW FAB**: ENAIRE and NAV Portugal.
- **BLUE MED**: DCAC Cyprus, ENAV, HCAA and MATS.
- **UK-Ireland**: IAA and NATS.
- **Danube**: BULATSA and ROMATSA.
- **DK-SE**: LFV and NAVIAIR.
- **Baltic**: Oro Navigacija and PANSA.
- **NEFAB**: Avinor, EANS, Finavia and LGS.

The Figure below represents a break-down of unit ATM/CNS provision costs into ATCO-hour productivity, ATCO employment costs per ATCO-hour and unit support costs at FAB level.

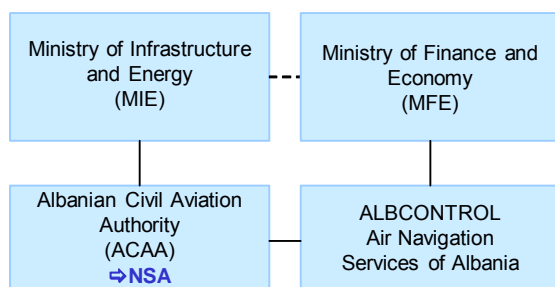


Annex 9 - Figure 0.1: Breakdown of cost-effectiveness indicator at FAB level, 2016

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ANNEX 10 – INDIVIDUAL ANSP FACT-SHEETS

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Institutional arrangements and links (2018)

Status (2018)

- Since May 1999 NATA, now ALBCONTROL, is a joint-stock company
- 100% State owned

National Supervisory Authority (NSA):

Albanian Civil Aviation Authority (ACAA)

Body responsible for:
Safety Regulation

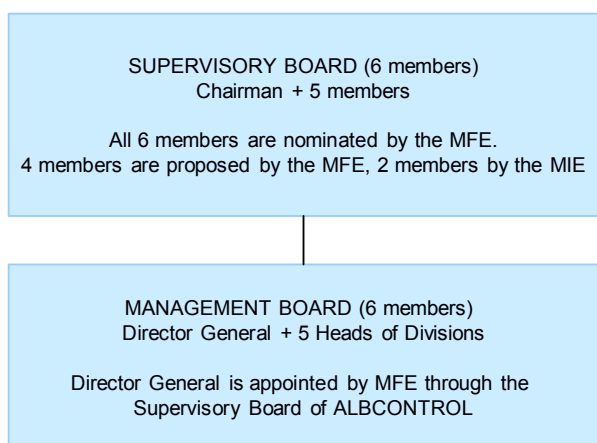
MIE and Albanian Civil Aviation Authority (ACAA)

Airspace Regulation

MIE and Albanian Civil Aviation Authority (ACAA)

Economic Regulation

Ministry of Finance and Economy (MFE)

Corporate governance structure (2018)

Albcontrol (2018)
CHAIRMAN OF SUPERVISORY BOARD:

Genci Gjonçaj

DIRECTOR GENERAL OF ALBCONTROL:

Belinda Balluku

HEAD OF THE ATS DEPARTMENT:

Sokol Reveli

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

Operational ATS units (2016)

- 1 ACC (Tirana)
- 1 APP (Tirana)
- 1 TWR (Tirana)
- 1 AFIS (Tirana)

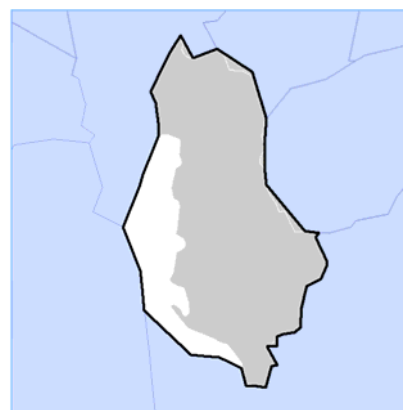
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	24
Gate-to-gate total costs (M€)	25
Gate-to-gate ATM/CNS provision costs (M€)	22
Gate-to-gate total ATM/CNS assets(M€)	40
Gate-to-gate ANS total capex (M€)	7
ATCOs in OPS	67
Gate-to-gate total staff (incl. MET staff*)	332
Total IFR flight-hours controlled by ANSP ('000)	39
IFR airport movements controlled by ANSP ('000)	22
En-route sectors open at maximum configuration	4
Minutes of ATFM delays ('000)	0

* if applicable

Size (2016)

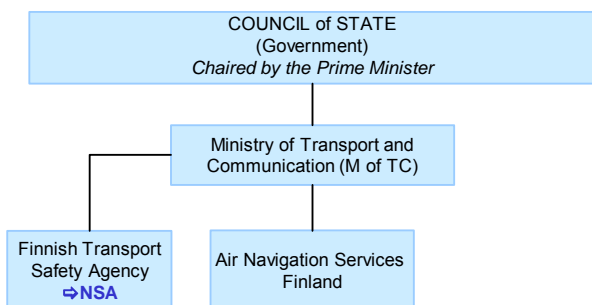
Size of controlled airspace: 36 000 km²



Air Navigation Services of the Czech Republic

www.rlp.cz

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Institutional arrangements and links (2018)

Status (2018)

- Public Limited Company
- Integrated civil/military ANSP
- 100% State-owned

National Supervisory Authority (NSA):

Finnish Transport Safety Agency

Body responsible for:
Safety Regulation

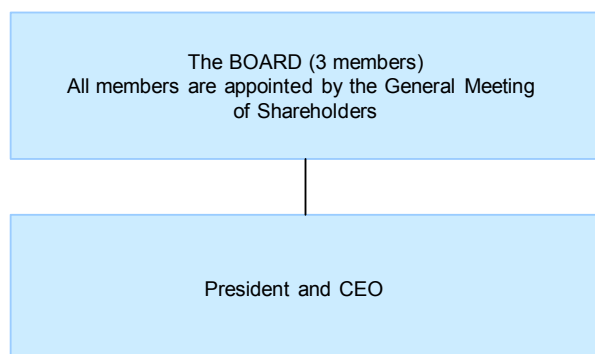
Finnish Transport Safety Agency

Airspace Regulation

Finnish Transport Safety Agency

Economic Regulation

Finnish Transport Safety Agency

Corporate governance structure (2018)

ANS Finland (2018)
CHAIRMAN OF THE ANS FINLAND BOARD:

Pertti Korhonen

PRESIDENT AND CEO:

Raine Luojus

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- ANS Finland (Finavia) operated in 23 airports in 2016
- Delegation of ATS in certain areas to LFV and Avinor
- 182 ATCOs in OPS reported below do not include those providing services to military OAT flights

Operational ATS units (2016)

- 1 ACC (Tampere)
- 5 APPs/TWRs (Helsinki, Jyväskylä, Kuopio, Tampere-Pirkkala, Rovaniemi)
- 1 Mil-APPs/TWRs (Halli)
- 10 TWRs
- 1 General Aviation Airport (Malmi)

*data above reflects the situation at the end of 2016

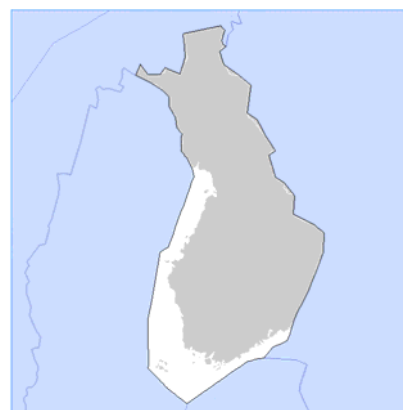
Key financial and operational figures (ACE 2016)

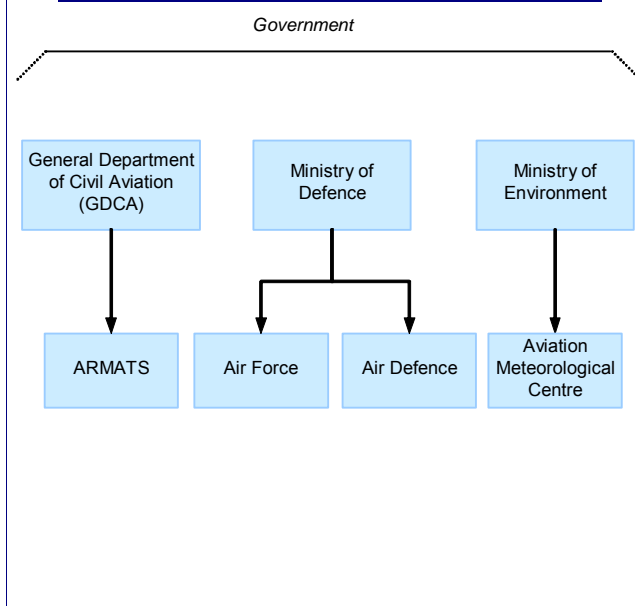
Gate-to-gate total revenues (M€)	62
Gate-to-gate total costs (M€)	69
Gate-to-gate ATM/CNS provision costs (M€)	64
Gate-to-gate total ATM/CNS assets(M€)	37
Gate-to-gate ANS total capex (M€)	3
ATCOs in OPS	182
Gate-to-gate total staff (incl. MET staff*)	337
Total IFR flight-hours controlled by ANSP ('000)	105
IFR airport movements controlled by ANSP ('000)	230
En-route sectors open at maximum configuration	6
Minutes of ATFM delays ('000)	23

* if applicable

Size (2016)

Size of controlled airspace: 410 000 km²



Institutional arrangements and links (2018)

Status (2018)

- Joint-stock company as of 1997
- 100% State-owned

National Supervisory Authority (NSA):

General Department of Civil Aviation (GDCA)

Body responsible for:
Safety Regulation

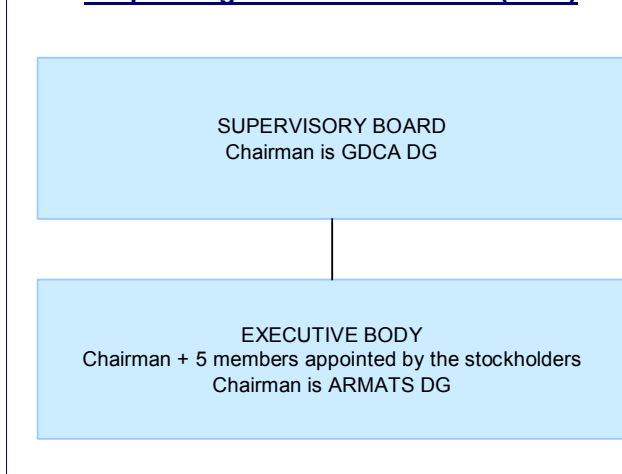
General Department of Civil Aviation (GDCA)

Airspace Regulation

General Department of Civil Aviation (GDCA) and Ministry of Defence

Economic Regulation

Tax Authorities

Corporate governance structure (2018)

ARMATS (2018)
CHAIRMAN OF THE SUPERVISORY BOARD:

Sergey Avetisyan

CHAIRMAN OF THE EXECUTIVE BODY:

Artur Gasparyan

DIRECTOR OF AIR TRAFFIC SERVICES:

Artur Papoyan

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

Operational ATS units (2016)

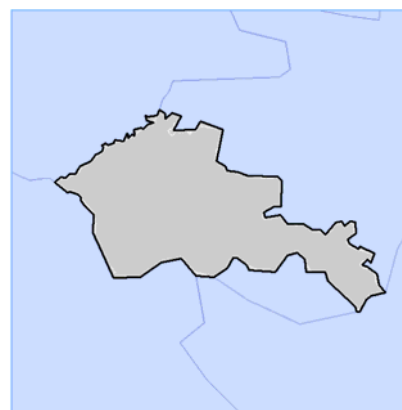
- 1 ACC (Yerevan)
- 2 APPs (Yerevan, Gyumri)
- 2 TWRs (Shirak, Zvartnots)

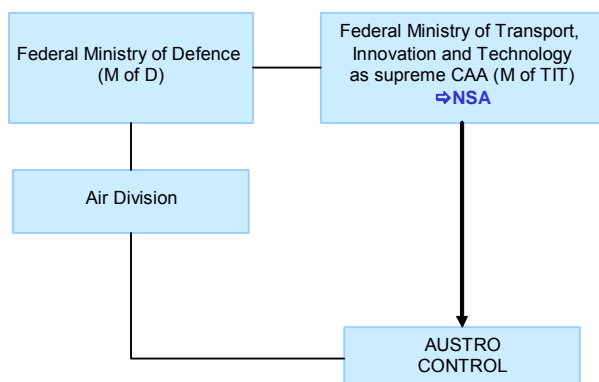
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	9
Gate-to-gate total costs (M€)	9
Gate-to-gate ATM/CNS provision costs (M€)	8
Gate-to-gate total ATM/CNS assets(M€)	11
Gate-to-gate ANS total capex (M€)	1
ATCOs in OPS	80
Gate-to-gate total staff (incl. MET staff*)	382
Total IFR flight-hours controlled by ANSP ('000)	10
IFR airport movements controlled by ANSP ('000)	19
En-route sectors open at maximum configuration	1
Minutes of ATFM delays ('000)	0

* if applicable

Size (2016)

 Size of controlled airspace: 29 700 km²


Institutional arrangements and links (2018)

Status (2018)

- Private limited company as of 1994
- 100% State-owned (Law makes provision for Austrian Airports to own up to 49 %)

National Supervisory Authority (NSA):

Federal Ministry of Transport, Innovation and Technology (M of TIT)

Body responsible for:
Safety Regulation

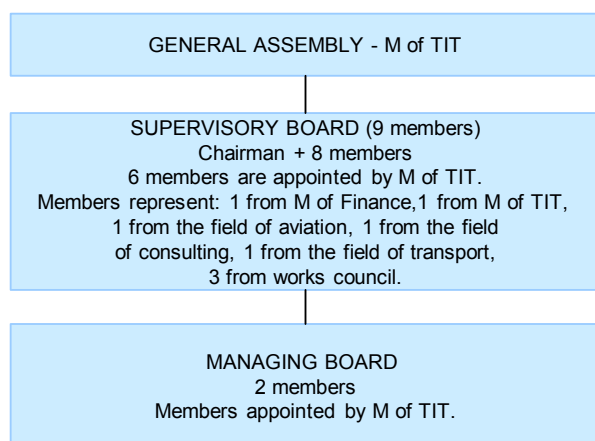
The power for regulatory decisions including safety oversight lies within the M of TIT

Airspace Regulation

M of TIT, normally on basis of proposals of Austro Control

Economic Regulation

Covered by the National Supervisory Authority

Corporate governance structure (2018)

Austro Control (2018)
CHAIRMAN OF THE SUPERVISORY BOARD:

Mag. Karin Zipperer

MANAGING BOARD:

Dr. Heinz Sommerbauer
Thomas Hoffmann, MSc

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

Operational ATS units (2016)

1 ACC (Wien)
6 APPs (Wien, Graz, Innsbruck, Klagenfurt, Linz, Salzburg)
6 TWRs

Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	246
Gate-to-gate total costs (M€)	227
Gate-to-gate ATM/CNS provision costs (M€)	196
Gate-to-gate total ATM/CNS assets(M€)	162
Gate-to-gate ANS total capex (M€)	20
ATCOs in OPS	295
Gate-to-gate total staff (incl. MET staff*)	856
Total IFR flight-hours controlled by ANSP ('000)	280
IFR airport movements controlled by ANSP ('000)	326
En-route sectors open at maximum configuration	12
Minutes of ATFM delays ('000)	171

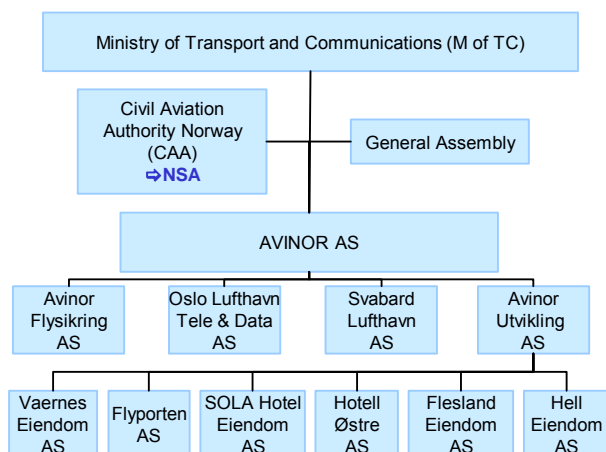
* if applicable

Size (2016)

Size of controlled airspace: 80 900 km²



Institutional arrangements and links (2018)



Status (2018)

- 100% owned by Avinor AS (state-owned)
- Civil ANSP
- Independent of CAA

National Supervisory Authority (NSA):

Civil Aviation Authority Norway (CAA)

Body responsible for:

Safety Regulation

Civil Aviation Authority Norway

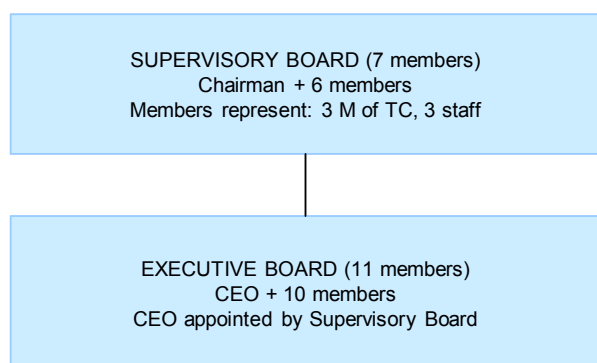
Airspace Regulation

Civil Aviation Authority Norway

Economic Regulation

Aeronautic charges are set annually by the Ministry of Transport and Communications

Corporate governance structure (2018)



Avinor Flysikring (2018)

CHAIRMAN OF THE SUPERVISORY BOARD:

Dag Falk-Petersen

CHIEF EXECUTIVE OFFICER:

Anders Kirsebom

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input checked="" type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

Operational ATS units (2016)

3 ACCs (Oslo ACC+Oslo APP+Farris APP), Stavanger ACC, Bodø (ACC+APP+Oceanic)
14 TWR/APP
5 TWR
1 APP (Møre)

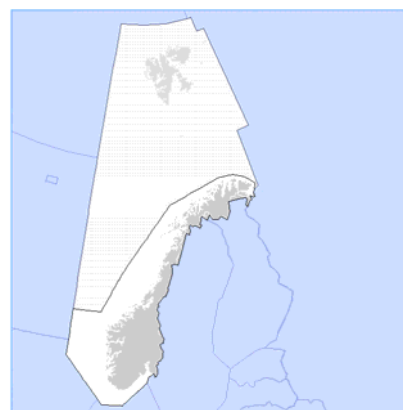
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	178
Gate-to-gate total costs (M€)	172
Gate-to-gate ATM/CNS provision costs (M€)	161
Gate-to-gate total ATM/CNS assets(M€)	94
Gate-to-gate ANS total capex (M€)	17
ATCOs in OPS	403
Gate-to-gate total staff (incl. MET staff*)	945
Total IFR flight-hours controlled by ANSP ('000)	366
IFR airport movements controlled by ANSP ('000)	656
En-route sectors open at maximum configuration	20
Minutes of ATFM delays ('000)	168

* if applicable

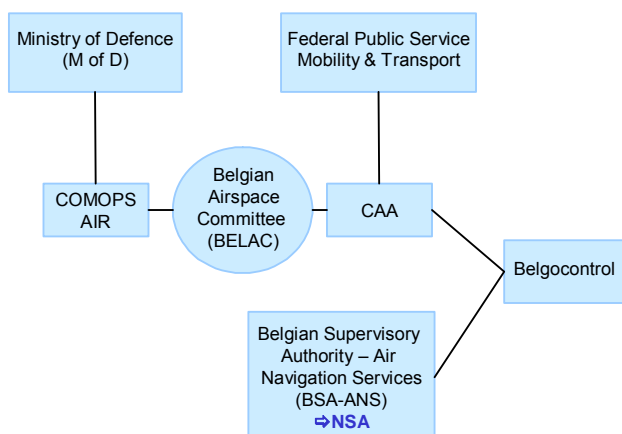
Size (2016)

Size of controlled airspace: 731 000 km²



Continental: 731 000 km² - Oceanic: 1 440 000 km²

Institutional arrangements and links (2018)



Status (2018)

- Public Autonomous Enterprise as of 1998 under a management contract
- 100% State-owned

National Supervisory Authority (NSA):

Belgian Supervisory Authority - Air Navigation Services (BSA-ANS)

Body responsible for:

Safety Regulation

Civil Aviation Authority

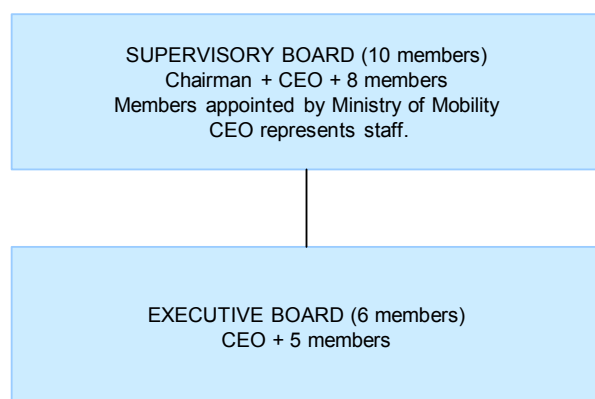
Airspace Regulation

Belgian Airspace Committee

Economic Regulation

Federal Public Service of Mobility and Transport

Corporate governance structure (2018)



Belgocontrol (2018)

CHAIRMAN OF THE SUPERVISORY BOARD:

Renaud Lorand

DIRECTOR GENERAL (CEO):

Johan Decuyper

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

- Belgocontrol controls lower airspace up to FL 245, including Luxembourg airspace above FL 145/165
- Upper airspace (> FL 245) is controlled by Maastricht UAC

Operational ATS units (2016)

- 1 ACC (Brussels)
- 4 APPs (Brussels, Liege, Charleroi, Oostende)
- 5 TWRs (Brussels, Antwerp, Liege, Charleroi, Oostende)

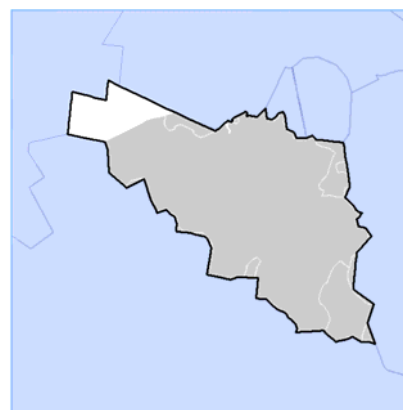
Key financial and operational figures (ACE 2016)

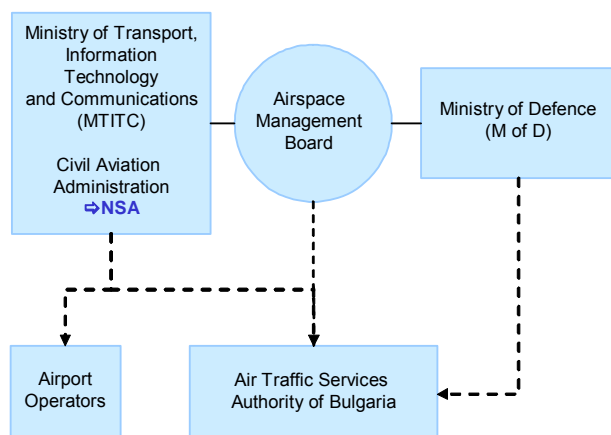
Gate-to-gate total revenues (M€)	217
Gate-to-gate total costs (M€)	208
Gate-to-gate ATM/CNS provision costs (M€)	147
Gate-to-gate total ATM/CNS assets (M€)	89
Gate-to-gate ANS total capex (M€)	4
ATCOs in OPS	225
Gate-to-gate total staff (incl. MET staff*)	759
Total IFR flight-hours controlled by ANSP ('000)	108
IFR airport movements controlled by ANSP ('000)	356
En-route sectors open at maximum configuration	7
Minutes of ATFM delays ('000)	412

* if applicable

Size (2016)

Size of controlled airspace: 39 500 km²



Institutional arrangements and links (2018)

Status (2018)

- State enterprise as of April 2001 (Art 53 §1 of the Civil Aviation Law)
- 100% State-owned

National Supervisory Authority (NSA):

Civil Aviation Administration

Body responsible for:
Safety Regulation

Civil Aviation Administration (Ministry of Transport, Information Technology and Communications (MTITC))

Airspace Regulation

Airspace Management Board

Economic Regulation

Ministry of Transport, Information Technology and Communications (MTITC)

Corporate governance structure (2018)

 MANAGEMENT BOARD (3 members)
 DG + 2 members

All members appointed by the MTITC.

BULATSA (2018)
CHAIRMAN OF THE MANAGEMENT BOARD:

Mrs. Veselina Karamileva

DIRECTOR GENERAL (CEO):

Mr. Georgi Peev

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

- Training of ATCOs

Operational ATS units (2016)

- 1 ACCs (Sofia)
- 3 APPs (Sofia, Varna, Burgas)
- 5 TWRs (Sofia, Varna, Burgas, Gorna Oriahovitza, Plovdiv)

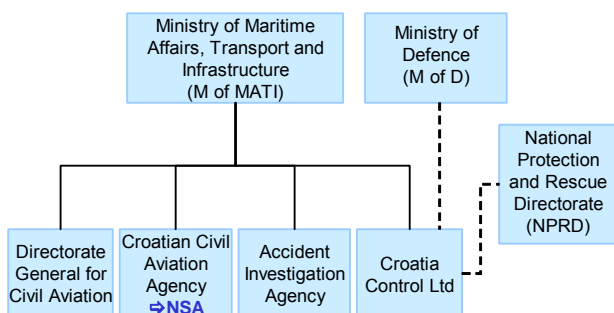
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	102
Gate-to-gate total costs (M€)	100
Gate-to-gate ATM/CNS provision costs (M€)	90
Gate-to-gate total ATM/CNS assets(M€)	105
Gate-to-gate ANS total capex (M€)	15
ATCOs in OPS	264
Gate-to-gate total staff (incl. MET staff*)	1 066
Total IFR flight-hours controlled by ANSP ('000)	256
IFR airport movements controlled by ANSP ('000)	89
En-route sectors open at maximum configuration	18
Minutes of ATFM delays ('000)	4

* if applicable

Size (2016)

 Size of controlled airspace: 145 000 km²


Institutional arrangements and links (2018)

Status (2018)

- Limited liability company as of 1st January 2000
- 100% State-owned
- Integrated civil/military ANSP

National Supervisory Authority (NSA):

Croatian Civil Aviation Agency (CCAA)

Body responsible for:
Safety Regulation

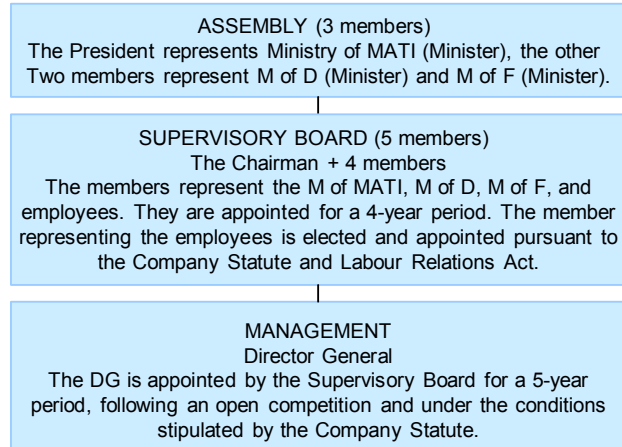
Directorate General for Civil Aviation

Airspace Regulation

M of MATI

Economic Regulation

State Law and Croatia Control Ltd

Corporate governance structure (2018)

Croatia Control (2018)
CHAIRMAN OF THE SUPERVISORY BOARD:

Dinko Staničić

DIRECTOR GENERAL:

Vlado Bagarić

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

After opening of Sarajevo ACC on 13-11-2014, ATS provision is in force over delegated part of FIR Sarajevo

Operational ATS units (2016)

- 1 ACC (Zagreb)
- 1 APP (Zagreb)
- 6 APPs/TWRs (Osijek, Rijeka, Pula, Zadar, Split, Dubrovnik)
- 4 TWRs (Lučko, Zagreb, Brač, Lošinj)

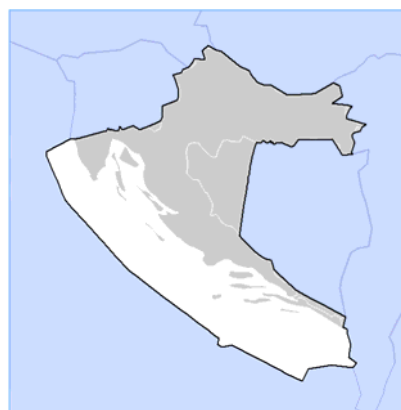
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	97
Gate-to-gate total costs (M€)	91
Gate-to-gate ATM/CNS provision costs (M€)	85
Gate-to-gate total ATM/CNS assets(M€)	63
Gate-to-gate ANS total capex (M€)	8
ATCOs in OPS	246
Gate-to-gate total staff (incl. MET staff*)	732
Total IFR flight-hours controlled by ANSP ('000)	205
IFR airport movements controlled by ANSP ('000)	98
En-route sectors open at maximum configuration	11
Minutes of ATFM delays ('000)	21

* if applicable

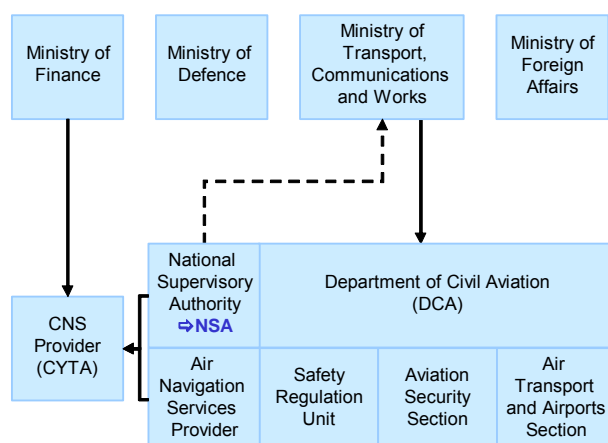
Size (2016)

Size of controlled airspace: 128 000 km²





Institutional arrangements and links (2018)



Status (2018)

- State body
- 100% State-owned

National Supervisory Authority (NSA):

Department of Civil Aviation

Body responsible for:

Safety Regulation

Department of Civil Aviation of Cyprus

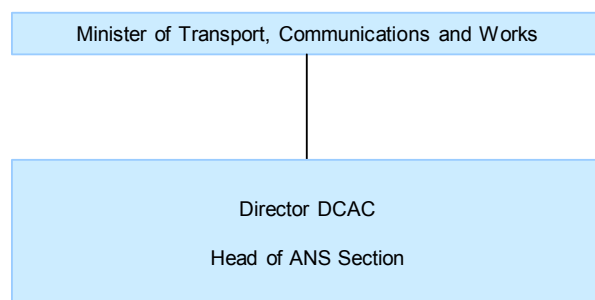
Airspace Regulation

Department of Civil Aviation of Cyprus

Economic Regulation

Ministry of Finance

Corporate governance structure (2018)



DCAC Cyprus (2018)

HEAD OF ANS SECTION (COO):

Nicos Nicolaou (ACC, Airspace, ATFM)

Persephone Papadopoulou (APPs, TWRs, AIS, Training)

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- DCAC Cyprus owns and operates 2 airport Control Towers and ARO units

Operational ATS units (2016)

- 1 ACC (Nicosia)
- 2 APPs/TWRs (Larnaca, Paphos)

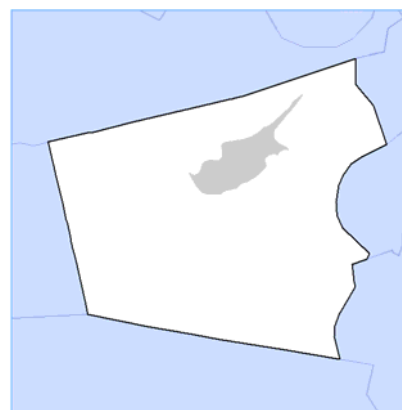
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	58
Gate-to-gate total costs (M€)	57
Gate-to-gate ATM/CNS provision costs (M€)	39
Gate-to-gate total ATM/CNS assets(M€)	16
Gate-to-gate ANS total capex (M€)	1
ATCOs in OPS	100
Gate-to-gate total staff (incl. MET staff*)	209
Total IFR flight-hours controlled by ANSP ('000)	152
IFR airport movements controlled by ANSP ('000)	70
En-route sectors open at maximum configuration	5
Minutes of ATFM delays ('000)	222

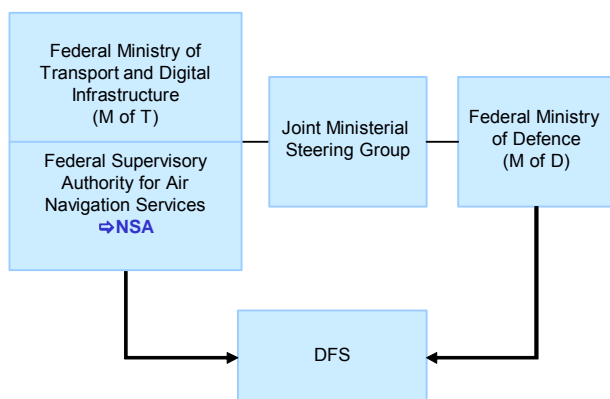
* if applicable

Size (2016)

Size of controlled airspace: 173 000 km²



Institutional arrangements and links (2018)



Status (2018)

- Limited liability company as of 1993, governed by Private Company Law
- 100% State-owned
- Integrated civil/military ANSP

National Supervisory Authority (NSA):

Federal Supervisory Authority for Air Navigation Services

Body responsible for:

Safety Regulation

Federal Supervisory Authority for Air Navigation Services (NSA)

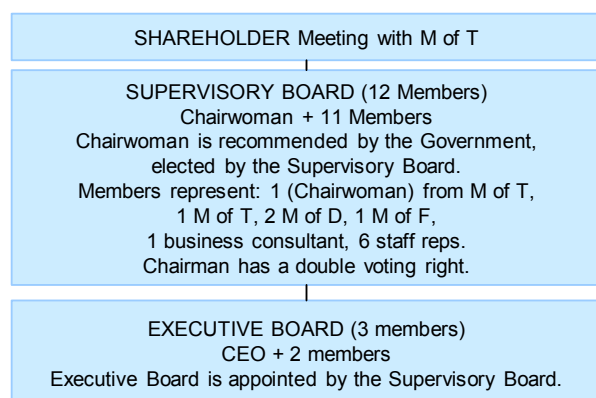
Airspace Regulation

Federal Ministry of Transport and Digital Infrastructure (MoT)

Economic Regulation

Federal Supervisory Authority for Air Navigation Services (NSA)

Corporate governance structure (2018)



DFS (2018)

CHAIRWOMAN OF THE SUPERVISORY BOARD:

Mrs. Dr. Martina Hinricher

CHAIRMAN OF THE EXECUTIVE BOARD:

Prof. Klaus-Dieter Scheurle

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- DFS controls both upper and lower airspace, except GAT for the upper airspace in North-Western Germany
- Other ANS
- Consulting, training, engineering & maintenance services

Operational ATS units (2016)

- 1 UAC (Karlsruhe)
- 3 ACCs/APPs (Bremen, Langen, München)
- 1 UAC (co-located with Maastricht UAC) for OAT in upper airspace in North-Western Germany
- 16 TWRs

Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	1 197
Gate-to-gate total costs (M€)	1 093
Gate-to-gate ATM/CNS provision costs (M€)	1 092
Gate-to-gate total ATM/CNS assets(M€)	644
Gate-to-gate ANS total capex (M€)	74
ATCOs in OPS	1 894
Gate-to-gate total staff (incl. MET staff*)	5 186
Total IFR flight-hours controlled by ANSP ('000)	1 396
IFR airport movements controlled by ANSP ('000)	2 017
En-route sectors open at maximum configuration	108
Minutes of ATFM delays ('000)	1 581

* if applicable

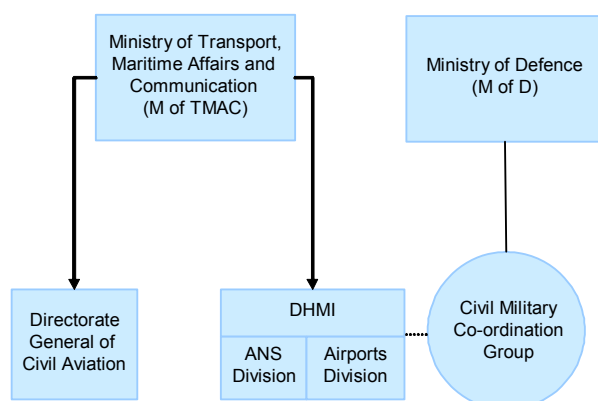
Size (2016)

Size of controlled airspace: 390 000 km²





Institutional arrangements and links (2018)



Status (2018)

- Autonomous State Enterprise
- 100% State-owned

National Supervisory Authority (NSA):

Not applicable since Turkey is not bound by SES Regulations

Body responsible for:

Safety Regulation

Directorate General of Civil Aviation

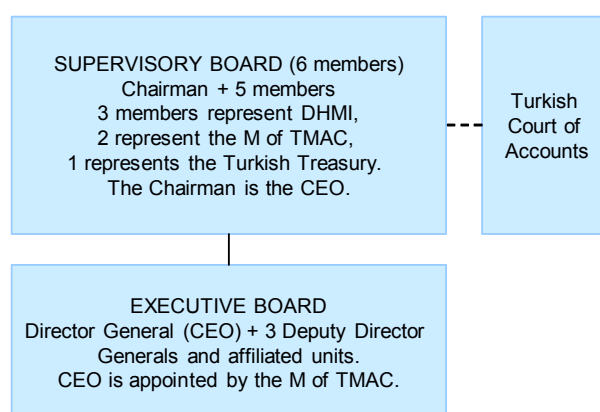
Airspace Regulation

General Directorate of DHMI

Economic Regulation

General Directorate of DHMI

Corporate governance structure (2018)



DHMI (2018)

CHAIRMAN OF THE SUPERVISORY BOARD:

Mrs. Funda Ocak

DIRECTOR GENERAL (CEO):

Mrs. Funda Ocak

DIRECTOR ANS DIVISION:

Mr. Mustafa Kiliç

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- DHMI is responsible for the administration of 49 State Airports. ATS services are provided by DHMI in 46 Airports

Operational ATS units (2016)

1 ACC (Ankara)
1 lower airspace ACC (İstanbul)
46 APPs
46 TWRs

Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	469
Gate-to-gate total costs (M€)	517
Gate-to-gate ATM/CNS provision costs (M€)	467
Gate-to-gate total ATM/CNS assets(M€)	823
Gate-to-gate ANS total capex (M€)	137
ATCOs in OPS	1 291
Gate-to-gate total staff (incl. MET staff*)	6 313
Total IFR flight-hours controlled by ANSP ('000)	1 251
IFR airport movements controlled by ANSP ('000)	1 232
En-route sectors open at maximum configuration	25
Minutes of ATFM delays ('000)	1 961

* if applicable

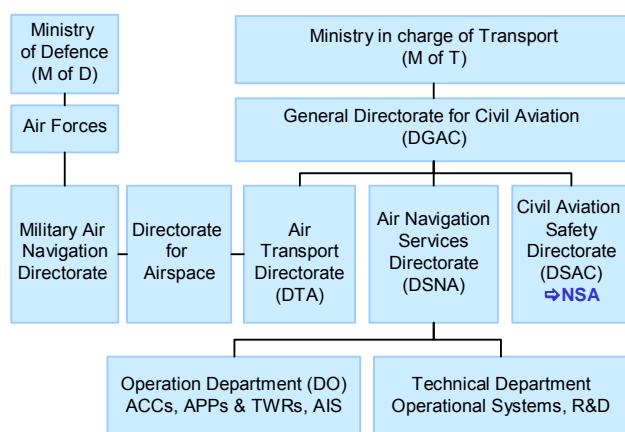
Size (2016)

Size of controlled airspace: 982 000 km²





Institutional arrangements and links (2018)



Status (2018)

- DSNA is a division of DGAC
- 100% State-owned

National Supervisory Authority (NSA):

Directorate for Civil Aviation Safety (DSAC)

Body responsible for:

Safety Regulation

Air Transport Directorate (DTA)

Airspace Regulation

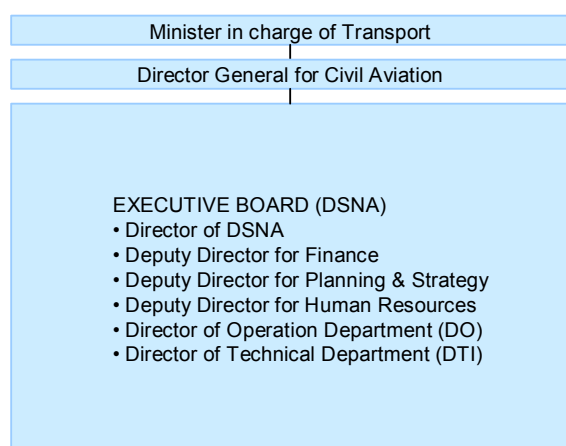
Air Transport Directorate (DTA)

Direction de la circulation aérienne militaire (DIRCAM)

Economic Regulation

Air Transport Directorate (DTA)

Corporate governance structure (2018)



DSNA (2018)

DIRECTOR OF DSNA:

M. Georges

DIRECTOR OF OPERATION DEPARTEMENT (DO):

M. Bruneau

DIRECTOR OF TECHNICAL DEPARTEMENT (DTI):

P. Planchon

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- Delegation of airspace to Skyguide and Jersey

Operational ATS units (2016)

5 ACCs
12 APPs/TWRs (i.e. Paris Orly, Paris CDG, Marseille, Lyon, Nice, Bordeaux, Toulouse, Clermont Ferrand, Montpellier, Strasbourg, Bâle-Mulhouse, Nantes)
65 TWRs

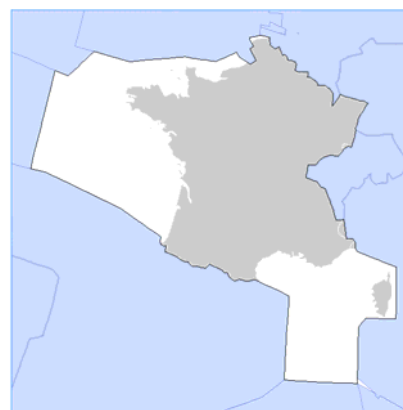
Key financial and operational figures (ACE 2016)

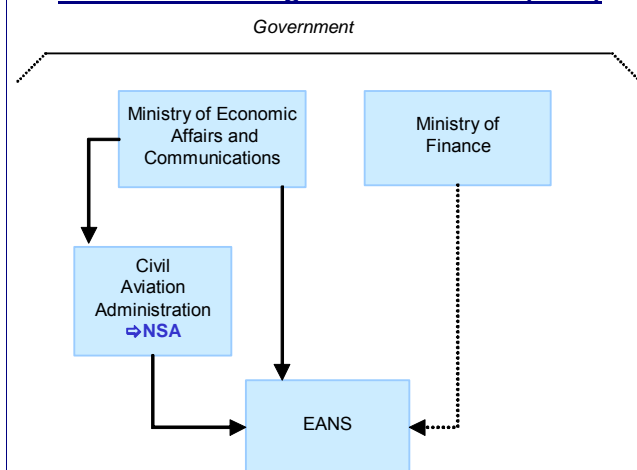
Gate-to-gate total revenues (M€)	1 637
Gate-to-gate total costs (M€)	1 530
Gate-to-gate ATM/CNS provision costs (M€)	1 254
Gate-to-gate total ATM/CNS assets(M€)	862
Gate-to-gate ANS total capex (M€)	187
ATCOs in OPS	2 859
Gate-to-gate total staff (incl. MET staff*)	7 669
Total IFR flight-hours controlled by ANSP ('000)	2 288
IFR airport movements controlled by ANSP ('000)	1 830
En-route sectors open at maximum configuration	102
Minutes of ATFM delays ('000)	4 170

* if applicable

Size (2016)

Size of controlled airspace: 1 010 000 km²



Institutional arrangements and links (2018)

Status (2018)

- Joint-stock company as of 1998
- 100% State-owned

National Supervisory Authority (NSA):

Civil Aviation Administration

Body responsible for:
Safety Regulation

Government of the Republic of Estonia

Safety Supervision is done by the Civil Aviation Administration (CAA)

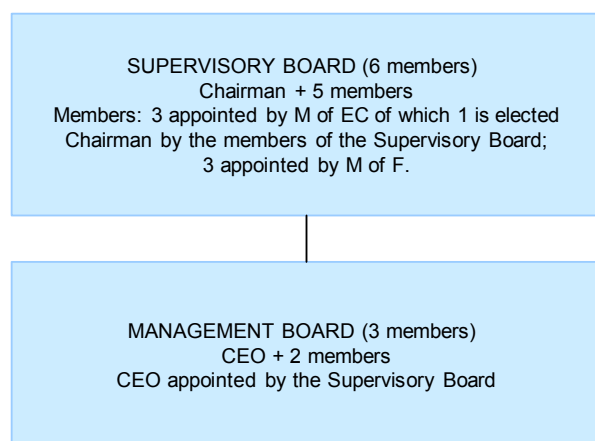
Airspace Regulation

Government of the Republic of Estonia

Economic Regulation

Government of the Republic of Estonia

(Ministry of Economic Affairs and Communications & Ministry of Finance)

Corporate governance structure (2018)

EANS (2018)
CHAIRMAN OF THE SUPERVISORY BOARD:

Viljar Arakas

CHAIRMAN OF THE MANAGEMENT BOARD & CEO:

Tanel Rautits

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- Tech. serv. (NAV/COMM/SUR), Aeronautical info serv.
- Consultancy services
- Control Tallinn Aerodrome
- Estonia is member of EUROCONTROL since 1st of January 2015

Operational ATS units (2016)

- 1 ACC (Tallinn)
- 2 APPs/TWRs (Tallinn, Tartu)

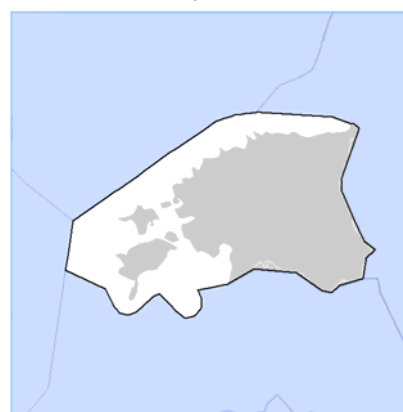
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	27
Gate-to-gate total costs (M€)	18
Gate-to-gate ATM/CNS provision costs (M€)	18
Gate-to-gate total ATM/CNS assets(M€)	22
Gate-to-gate ANS total capex (M€)	3
ATCOs in OPS	57
Gate-to-gate total staff (incl. MET staff*)	179
Total IFR flight-hours controlled by ANSP ('000)	68
IFR airport movements controlled by ANSP ('000)	39
En-route sectors open at maximum configuration	3
Minutes of ATFM delays ('000)	5

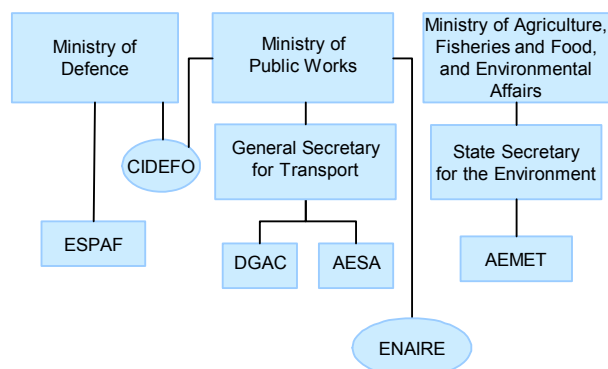
* if applicable

Size (2016)

Size of controlled airspace: 77 400 km²



Institutional arrangements and links (2018)



Status (2018)

- Business Public Entity attached to Ministry of Public Works
- A company with specific status (governed by Private Law, except when acting in its administrative capacity)
- 100% State-owned

National Supervisory Authority (NSA):

- AESA (Spanish Aviation Safety State Agency) (for ENAIRE)
- Spanish Air Force Staff (for MIL)
- Secretary of State for the Environment (for MET)

Body responsible for:

Safety Regulation

Spanish Civil Aviation Authority - Government
AESA - Government

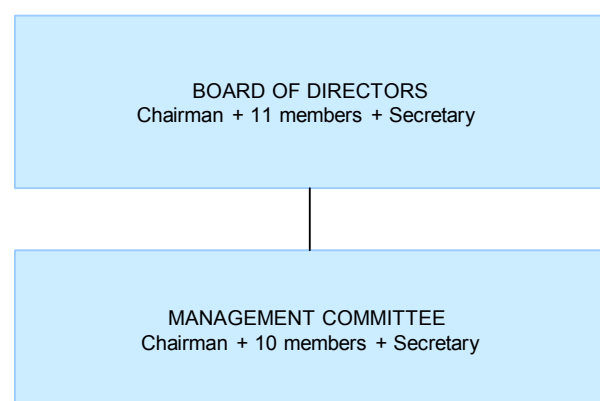
Airspace Regulation

Spanish Civil Aviation Authority - Government
AESA - Government

Economic Regulation

Government

Corporate governance structure (2018)



ENAIRE (2018)

CHAIRMAN OF THE BOARD OF DIRECTORS:

Julio Gómez-Pomar Rodríguez

DIRECTOR GENERAL OF ENAIRE:

Ángel Luis Arias Serrano

DIRECTOR OF AIR NAVIGATION SERVICES:

Enrique Maurer Somolinos

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

Operational ATS units (2016)

5 ACCs (Madrid, Barcelona, Canary Islands, Palma, Sevilla)
17 APPs (3 stand-alone APPs + 14 APPs co-located with TWR units)
22 TWRs

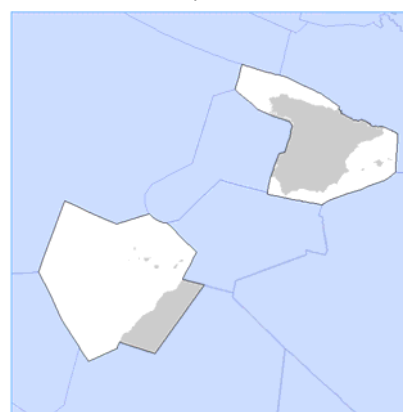
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	938
Gate-to-gate total costs (M€)	836
Gate-to-gate ATM/CNS provision costs (M€)	758
Gate-to-gate total ATM/CNS assets(M€)	575
Gate-to-gate ANS total capex (M€)	71
ATCOs in OPS	1 703
Gate-to-gate total staff (incl. MET staff*)	3 622
Total IFR flight-hours controlled by ANSP ('000)	1 392
IFR airport movements controlled by ANSP ('000)	1 407
En-route sectors open at maximum configuration	72
Minutes of ATFM delays ('000)	1 330

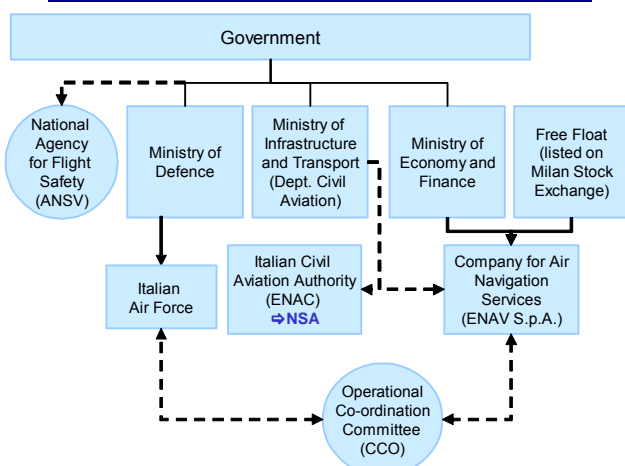
* if applicable

Size (2016)

Size of controlled airspace: 2 190 000 km²



Institutional arrangements and links (2018)



Status (2018)

- Listed Company
- 53,28% State-owned by Ministry of Economy and Finance
- 46,72% Free Float (listed on Milan Stock Exchange)

National Supervisory Authority (NSA):

Italian Civil Aviation Authority (ENAC)

Body responsible for:

Safety Regulation

Italian Civil Aviation Authority (ENAC) and Ministry of Infrastructure and Transport

Airspace Regulation

Italian Civil Aviation Authority (ENAC)

Economic Regulation

Ministry of Infrastructure and Transport and ENAC review annually ANS charges in co-operation with Ministry of Economy and Finance and Ministry of Defence

Corporate governance structure (2018)



ENAV (2018)

CHAIRMAN:

Roberto Scaramella

CEO:

Roberta Neri

MEMBERS OF THE ADMINISTRATION BOARD:

Giuseppe Acierno
Maria Teresa Di Matteo
Nicola Maione
Fabiola Mascardi
Carlo Paris
Antonio Santi
Mario Vinzia

DIRECTOR GENERAL:

Massimo Bellizzi

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

- AIS, ATM and CNS
- Training and licensing of ATCO's
- R&D consultancy services
- Cartography and Airspace design
- Aerodrome weather services, Flight Calibration services

Operational ATS units (2016)

4 ACCs (Milan, Padua, Rome, Brindisi)
20 APPs co-located within TWR units + 5 APPs co-located within ACC units
34 TWRs (including 18 low traffic airports not included in ACE data analysis)
2 AFUUs where TWR is provided at specific hours (low traffic airports not included in ACE data analysis)
9 AFUUs (low traffic airports not included in ACE data analysis)
*data above reflects the situation at the end of 2016

Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	811
Gate-to-gate total costs (M€)	754
Gate-to-gate ATM/CNS provision costs (M€)	684
Gate-to-gate total ATM/CNS assets(M€)	925
Gate-to-gate ANS total capex (M€)	98
ATCOs in OPS	1 442
Gate-to-gate total staff (incl. MET staff*)	3 170
Total IFR flight-hours controlled by ANSP ('000)	1 021
IFR airport movements controlled by ANSP ('000)	1 257
En-route sectors open at maximum configuration	60
Minutes of ATFM delays ('000)	92

* if applicable

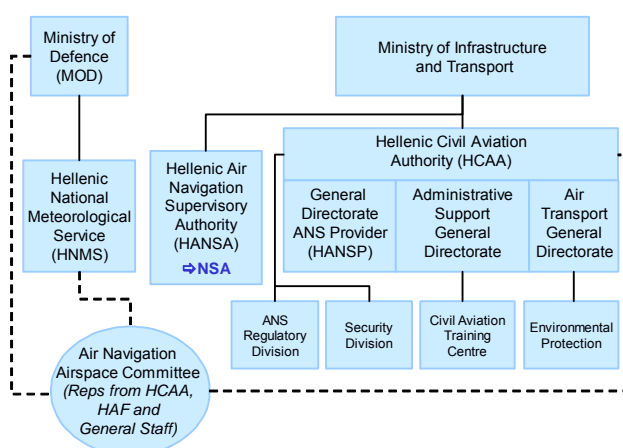
Size (2016)

Size of controlled airspace: 732 000 km²





Institutional arrangements and links (2018)



Status (2018)

- State body
- 100% State-owned

National Supervisory Authority (NSA):

Hellenic Air Navigation Supervisory Authority (HANSA)

Body responsible for:

Safety Regulation

Hellenic Civil Aviation Authority

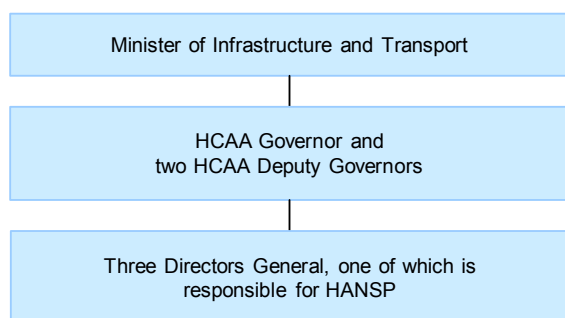
Airspace Regulation

Air Navigation Airspace Committee

Economic Regulation

- Ministry of Infrastructure and Transport
- HCAA for charges
- Ministry of Finance for HCAA Budget

Corporate governance structure (2018)



HCAA / HANSP (2018)

GOVERNOR:

K. Lintzerakos

ACTING DIRECTOR GENERAL OF HANSP:

C. Andrikopoulou

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

Operational ATS units (2016)

1 ACC (LGGM and LGMD)
16 APPs
18 TWRs
15 AFISs

Key financial and operational figures (ACE 2016)

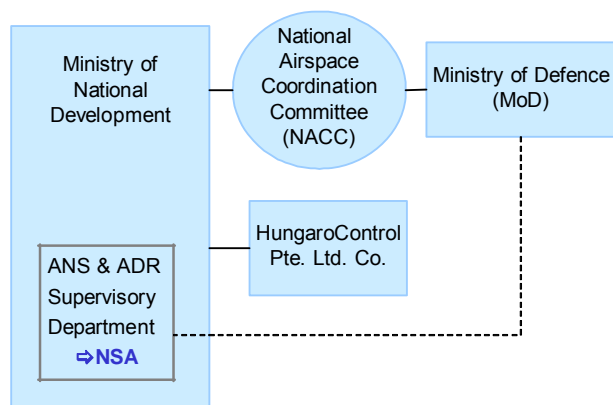
Gate-to-gate total revenues (M€)	198
Gate-to-gate total costs (M€)	164
Gate-to-gate ATM/CNS provision costs (M€)	146
Gate-to-gate total ATM/CNS assets (M€)	14
Gate-to-gate ANS total capex (M€)	8
ATCOs in OPS	480
Gate-to-gate total staff (incl. MET staff*)	1 633
Total IFR flight-hours controlled by ANSP ('000)	482
IFR airport movements controlled by ANSP ('000)	439
En-route sectors open at maximum configuration	12
Minutes of ATFM delays ('000)	547

* if applicable

Size (2016)

Size of controlled airspace: 538 000 km²



Institutional arrangements and links (2018)

Status (2018)

- HungaroControl was set up on January 1st 2002
- Registered as Private Limited Company as of 22 November 2006
- Operates as a Private Limited Company as of 1st January 2007
- 100% State-owned

National Supervisory Authority (NSA):

Aviation Authority

Body responsible for:
Safety Regulation

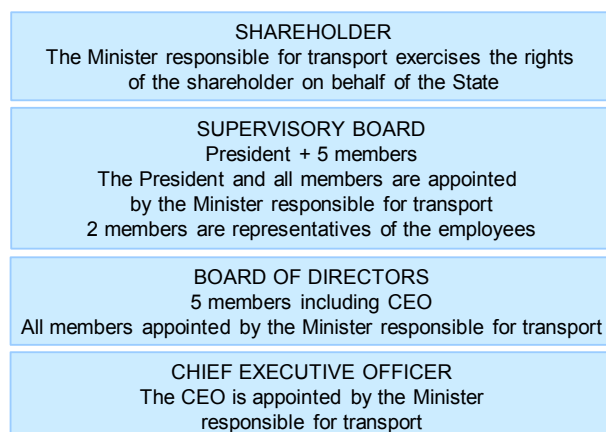
Ministry of National Development

Airspace Regulation

Govt., Ministry of National Development

Economic Regulation

Govt., Ministry of National Development

Corporate governance structure (2018)

HungaroControl (2018)
CHAIRMAN OF THE SUPERVISORY BOARD:

Dr. Alex Bozóky

CHAIRMAN OF THE BOARD OF DIRECTORS:

Attila Márton

CHIEF EXECUTIVE OFFICER (CEO):

Kornél Szepessy

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

- Entry Point Central Ltd. (49% HungaroControl owned company) provides training activities.
- HungaroControl provides ATM unit training.
- From 3rd of April 2014 HungaroControl provides air traffic services in the KFOR sector.

Operational ATS units (2016)

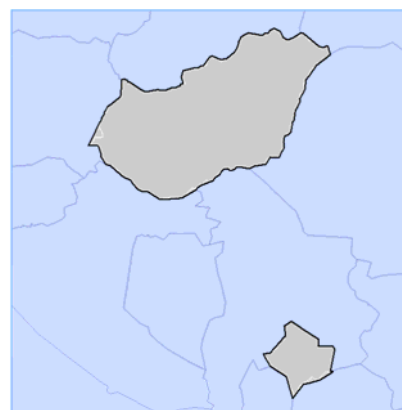
- 1 ACC (Budapest)
- 1 APP (Budapest)
- 1 TWR (Budapest)
- 8 AFISs

Key financial and operational figures (ACE 2016)

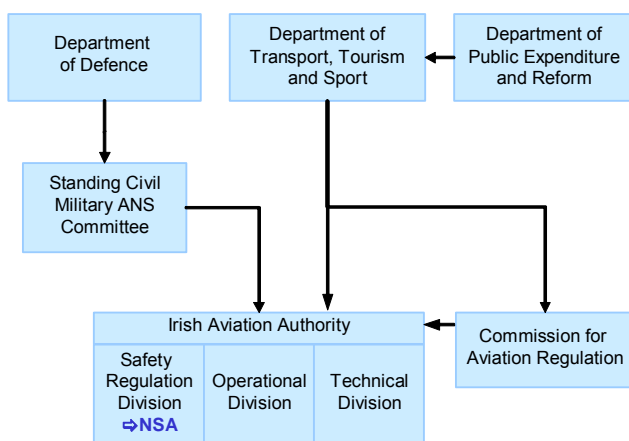
Gate-to-gate total revenues (M€)	125
Gate-to-gate total costs (M€)	107
Gate-to-gate ATM/CNS provision costs (M€)	98
Gate-to-gate total ATM/CNS assets(M€)	65
Gate-to-gate ANS total capex (M€)	10
ATCOs in OPS	171
Gate-to-gate total staff (incl. MET staff*)	758
Total IFR flight-hours controlled by ANSP ('000)	238
IFR airport movements controlled by ANSP ('000)	96
En-route sectors open at maximum configuration	9
Minutes of ATFM delays ('000)	58

* if applicable

Size (2016)

 Size of controlled airspace: 104 200 km²

 Hungary area: 92 700 km² - KFOR sector: 11 500 km²

Institutional arrangements and links (2018)



Status (2018)

- Commercial company as of 1994 governed by Companies Acts, 1963 to 2009
- 100% State-owned (Department of Public Expenditure and Reform) - IAA receives no funding or loans from the exchequer

National Supervisory Authority (NSA):

Safety Regulation Division

Body responsible for:

Safety Regulation

IAA Safety Regulation Division

Airspace Regulation

IAA Safety Regulation Division

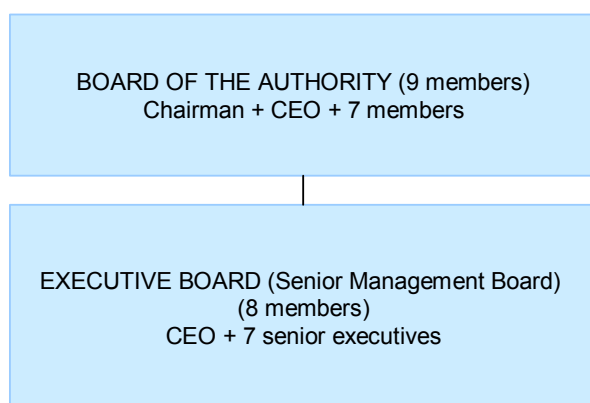
Economic Regulation

NSA responsible for Economic Regulation in the context of en-route charges

Commission for Aviation Regulation (established under the Aviation Regulation Act in 2001)

The Act requires the Commission to make a determination specifying the maximum levels of terminal navigation charges

Corporate governance structure (2018)



IAA (2018)

CHAIRMAN OF THE BOARD OF AUTHORITY:

Anne Nolan

CHIEF EXECUTIVE DESIGNATE:

Peter Kearney

DIRECTOR OF OPERATIONS (ACTING):

Billy Hann

DIRECTOR OF TECHNICAL DIVISION:

Philip Hughes

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input checked="" type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

Operational ATS units (2016)

2 ACCs (Dublin, Shannon)
3 APPs (Dublin, Shannon, Cork)
3 TWRs (Dublin, Shannon, Cork)

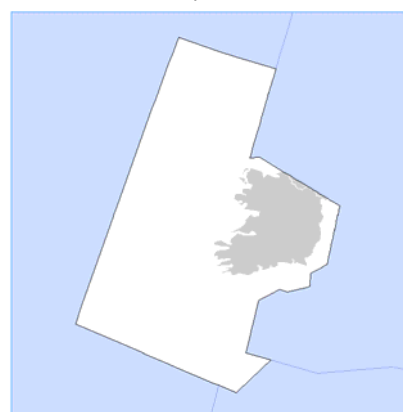
Key financial and operational figures (ACE 2016)

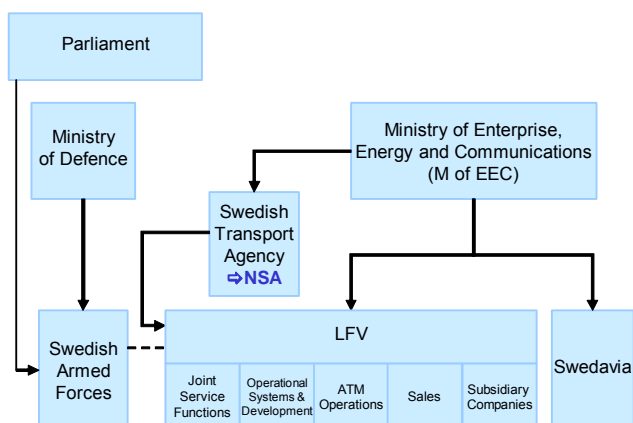
Gate-to-gate total revenues (M€)	149
Gate-to-gate total costs (M€)	132
Gate-to-gate ATM/CNS provision costs (M€)	111
Gate-to-gate total ATM/CNS assets(M€)	76
Gate-to-gate ANS total capex (M€)	14
ATCOs in OPS	211
Gate-to-gate total staff (incl. MET staff*)	428
Total IFR flight-hours controlled by ANSP ('000)	310
IFR airport movements controlled by ANSP ('000)	259
En-route sectors open at maximum configuration	14
Minutes of ATFM delays ('000)	20

* if applicable

Size (2016)

Size of controlled airspace: 457 000 km²



Institutional arrangements and links (2018)

Status (2018)

- Public Enterprise
- 100% State-owned

National Supervisory Authority (NSA):

Swedish Transport Agency

Body responsible for:

Safety Regulation

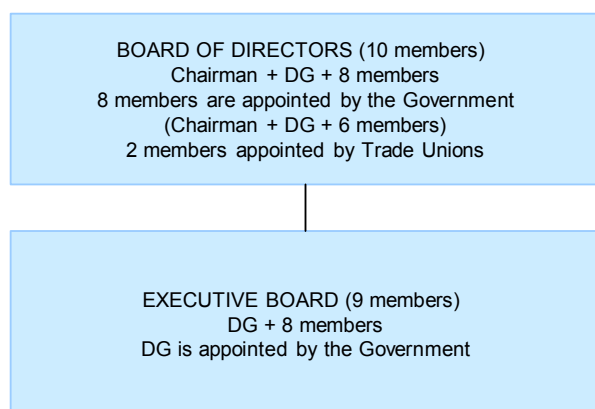
Swedish Transport Agency

Airspace Regulation

Swedish Transport Agency

Economic Regulation

Swedish Transport Agency

Corporate governance structure (2018)

LFV (2018)

CHAIRMAN OF THE BOARD OF DIRECTORS:

Jan Olson

DIRECTOR GENERAL:

Ann Persson Grivas

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

Operational ATS units (2016)

2 ACCs (Stockholm and Malmö)
1 RTC (Remote Tower Center in Sundsvall providing services at Örnsköldsvik)
17 APPs (2 combined with ACCs, 1 separate unit and 14 combined with TWRs)
21 TWRs

Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	189
Gate-to-gate total costs (M€)	182
Gate-to-gate ATM/CNS provision costs (M€)	180
Gate-to-gate total ATM/CNS assets(M€)	114
Gate-to-gate ANS total capex (M€)	15
ATCOs in OPS	440
Gate-to-gate total staff (incl. MET staff*)	933
Total IFR flight-hours controlled by ANSP ('000)	428
IFR airport movements controlled by ANSP ('000)	477
En-route sectors open at maximum configuration	26
Minutes of ATFM delays ('000)	94

* if applicable

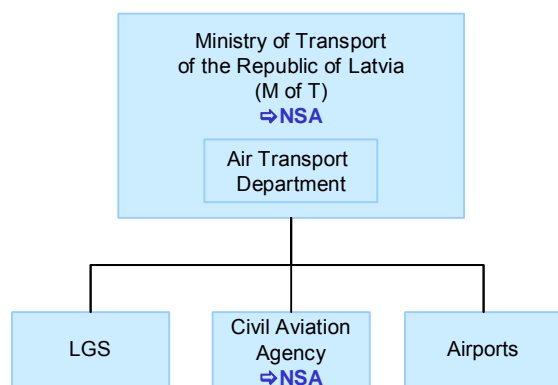
Size (2016)

Size of controlled airspace: 627 000 km²



www.lgs.lv

Institutional arrangements and links (2018)



Status (2018)

- Joint-stock company since 1997
- 100% State-owned (Ministry of Transport)

National Supervisory Authority (NSA):

- MoT (for policy and economic issues)
- Civil Aviation Agency (for safety, operational aspects, certification and licensing issues)

Body responsible for:

Safety Regulation

Civil Aviation Agency

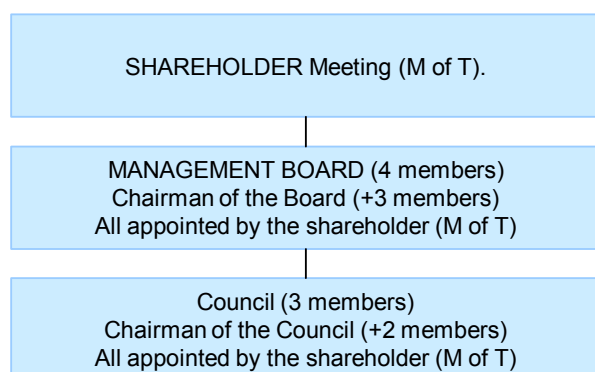
Airspace Regulation

Civil Aviation Agency

Economic Regulation

Air Transport Department and Cabinet of Ministers (Government)

Corporate governance structure (2018)



LGS (2018)

SHAREHOLDER'S REPRESENTATIVE:

Dzineta Innusa (Ministry of Transport, Deputy State Secretary for Legal and Administrative Affairs)

CHAIRMAN OF THE BOARD:

Davids Taurins

CHAIRMAN OF THE COUNCIL:

Dins Merirands

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

- ATC services delegated to Latvia by Lithuania over a part of the Baltic Sea

Operational ATS units (2016)

- 1 ACC (Riga)
- 2 APPs (Riga, Liepaja)
- 1 TWR (Riga)
- 1 AFIS/FIC* (Liepaja)

*FIC for western part of Riga FIR

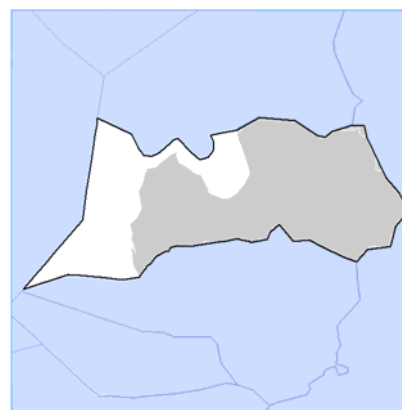
Key financial and operational figures (ACE 2016)

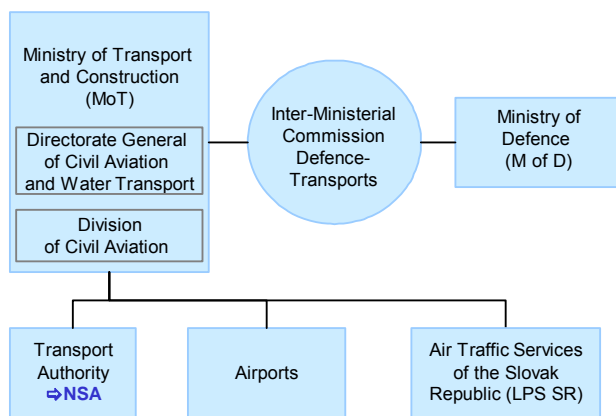
Gate-to-gate total revenues (M€)	25
Gate-to-gate total costs (M€)	26
Gate-to-gate ATM/CNS provision costs (M€)	22
Gate-to-gate total ATM/CNS assets (M€)	22
Gate-to-gate ANS total capex (M€)	7
ATCOs in OPS	92
Gate-to-gate total staff (incl. MET staff*)	353
Total IFR flight-hours controlled by ANSP ('000)	75
IFR airport movements controlled by ANSP ('000)	68
En-route sectors open at maximum configuration	4
Minutes of ATFM delays ('000)	0

* if applicable

Size (2016)

Size of controlled airspace: 95 900 km²



Institutional arrangements and links (2018)

Status (2018)

- State-owned enterprise as of January 2000
- 100% State-owned

National Supervisory Authority (NSA):

Transport Authority

Body responsible for:
Safety Regulation

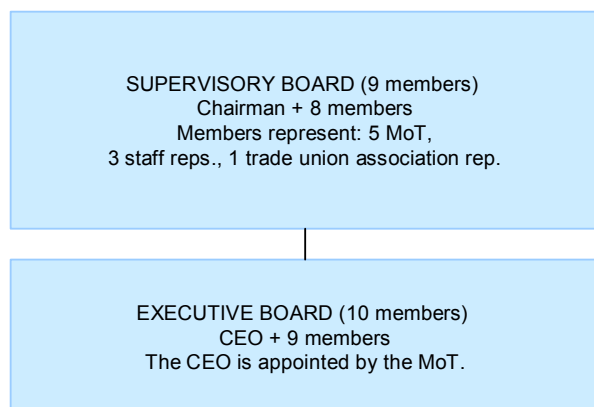
Ministry of Transport and Construction

Airspace Regulation

Ministry of Transport and Construction

Economic Regulation

Ministry of Transport and Construction and other State bodies

Corporate governance structure (2018)

LPS (2018)
CHAIRPERSON OF THE SUPERVISORY BOARD:

Stanislav Szabo

DIRECTOR GENERAL (CEO):

Blažej Zaujec

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

Operational ATS units (2016)

- 1 ACC (Bratislava)
- 2 APPs (Bratislava, Kosice)
- 5 TWRs (Bratislava, Kosice, Piestany, Poprad and Zilina)
- 1 Central ATS Reporting Office (Bratislava)

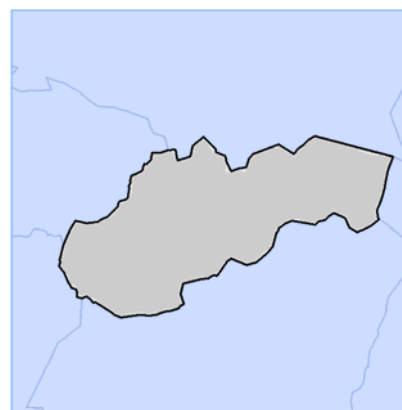
Key financial and operational figures (ACE 2016)

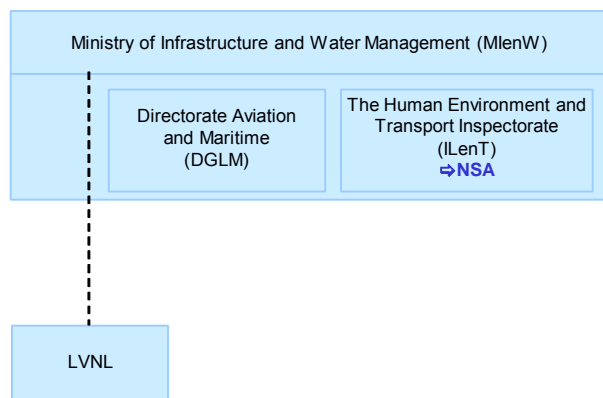
Gate-to-gate total revenues (M€)	66
Gate-to-gate total costs (M€)	67
Gate-to-gate ATM/CNS provision costs (M€)	59
Gate-to-gate total ATM/CNS assets(M€)	49
Gate-to-gate ANS total capex (M€)	3
ATCOs in OPS	89
Gate-to-gate total staff (incl. MET staff*)	486
Total IFR flight-hours controlled by ANSP ('000)	98
IFR airport movements controlled by ANSP ('000)	31
En-route sectors open at maximum configuration	5
Minutes of ATFM delays ('000)	15

* if applicable

Size (2016)

Size of controlled airspace: 48 700 km²




Institutional arrangements and links (2018)

Status (2018)

- Corporate Entity as of 1993 (by Air Traffic Law)
- 100% State-owned

National Supervisory Authority (NSA):

The Human Environment and Transport Inspectorate (ILenT)

Body responsible for:
Safety Regulation

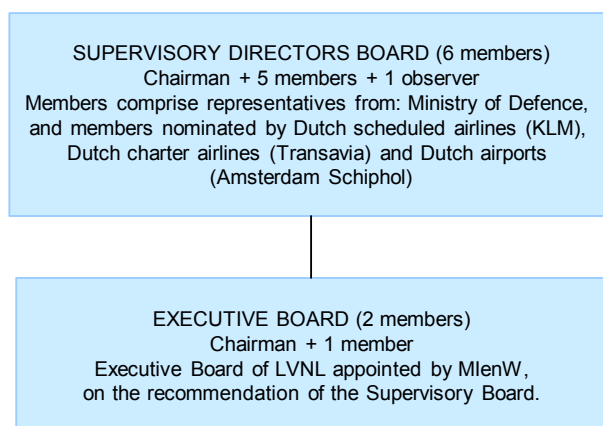
Directorate Aviation and Maritime (DGLM)

Airspace Regulation

Directorate Aviation and Maritime (DGLM)

Economic Regulation

Directorate Aviation and Maritime (DGLM)

Corporate governance structure (2018)

LVNL (2018)
CHAIRMAN OF THE SUPERVISORY BOARD:

G.J.N.H. Cerfontaine

CHAIRMAN OF THE EXECUTIVE BOARD (CEO):

Mr. M.W.A. Dorst

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- Controls lower airspace up to FL 245

Operational ATS units (2016)

- 1 ACC (Amsterdam)
- 3 APPs (Schiphol, Eelde, Beek)
- 4 TWRs (Schiphol, Rotterdam, Eelde, Beek)

- New Millingen ACC (Military ACC) is not included in ACE data analysis
- Rotterdam APP has been located in Schiphol since 2002

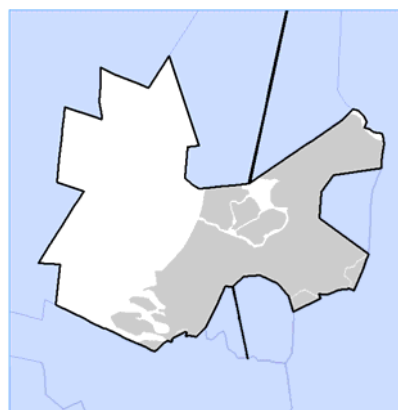
Key financial and operational figures (ACE 2016)

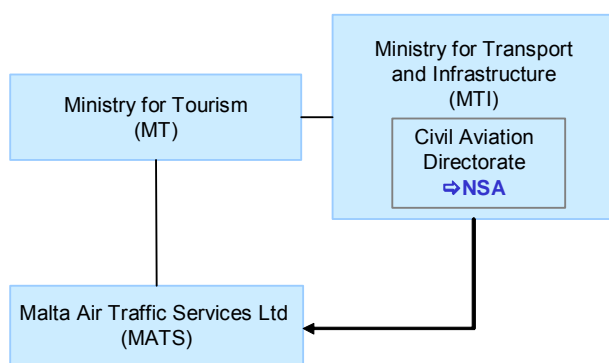
Gate-to-gate total revenues (M€)	219
Gate-to-gate total costs (M€)	194
Gate-to-gate ATM/CNS provision costs (M€)	183
Gate-to-gate total ATM/CNS assets(M€)	132
Gate-to-gate ANS total capex (M€)	29
ATCOs in OPS	216
Gate-to-gate total staff (incl. MET staff*)	981
Total IFR flight-hours controlled by ANSP ('000)	164
IFR airport movements controlled by ANSP ('000)	534
En-route sectors open at maximum configuration	5
Minutes of ATFM delays ('000)	592

* if applicable

Size (2016)

Size of controlled airspace: 53 100 km²



Institutional arrangements and links (2018)

Status (2018)

- Malta Air Traffic Services Ltd (Reg. no. C27965) is a fully Government owned company. MATS has been operating as the sole ANSP for Malta since the 1st January 2002

National Supervisory Authority (NSA):

Civil Aviation Directorate Malta (CADM)

Body responsible for:

Safety Regulation

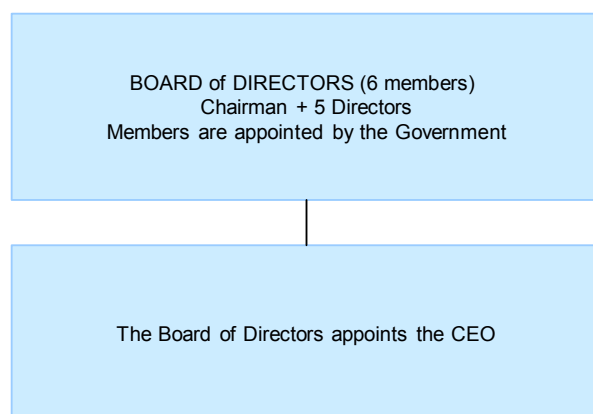
Civil Aviation Directorate

Airspace Regulation

Civil Aviation Directorate

Economic Regulation

Civil Aviation Directorate

Corporate governance structure (2018)

MATS (2018)
CHAIRMAN OF BOARD OF DIRECTORS:

Maj. Tony Abela

CEO:

Dr. Kenneth Chircop

HEAD OF ATS DIVISION:

Mr. Robert Sant

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- MATS controls portions of airspace delegated to Malta ACC by Rome ACC

Operational ATS units (2016)

1 ACC/APP (Malta)
1 TWR/APP (Luqa)
1 AFIS

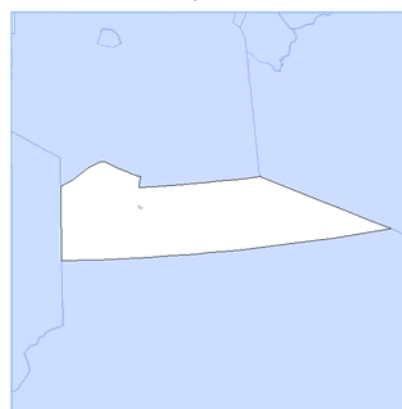
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	31
Gate-to-gate total costs (M€)	21
Gate-to-gate ATM/CNS provision costs (M€)	18
Gate-to-gate total ATM/CNS assets(M€)	10
Gate-to-gate ANS total capex (M€)	1
ATCOs in OPS	52
Gate-to-gate total staff (incl. MET staff*)	146
Total IFR flight-hours controlled by ANSP ('000)	79
IFR airport movements controlled by ANSP ('000)	45
En-route sectors open at maximum configuration	2
Minutes of ATFM delays ('000)	0

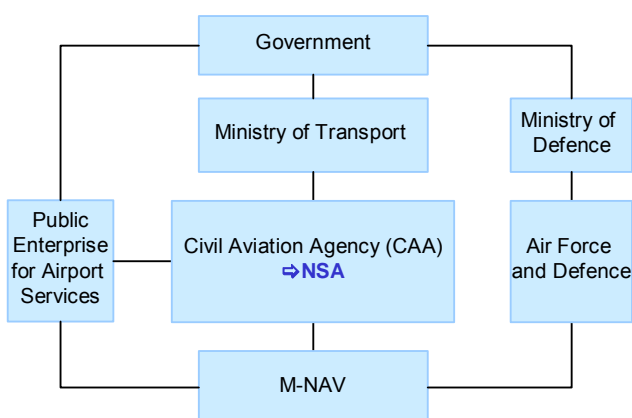
* if applicable

Size (2016)

Size of controlled airspace: 231 000 km²



Institutional arrangements and links (2018)



Status (2018)

- Joint-stock company
- 100% State-owned

National Supervisory Authority (NSA):

Civil Aviation Agency (CAA)

Body responsible for:

Safety Regulation

Safety Dept. of Civil Aviation Agency

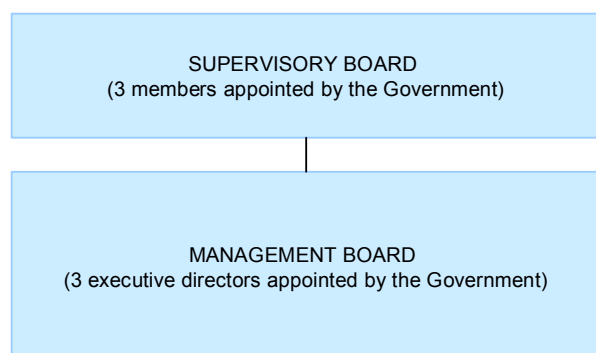
Airspace Regulation

Civil-military Aviation Committee

Economic Regulation

Government, Civil Aviation Agency

Corporate governance structure (2018)



M-NAV (2018)

CHAIRMAN OF THE SUPERVISORY BOARD:

Ms. Vesna Pavlov

DIRECTOR GENERAL OF CAA:

Mr. Goran Jandreoski

DIRECTOR OF ANS DEPARTEMENT:

Mr. Nikolche Taseski

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

Operational ATS units (2016)

- 1 ACC (Skopje)
- 2 APPs (Skopje and Ohrid)
- 2 TWRs (Skopje and Ohrid)
- 1 AFIS (Skopje)

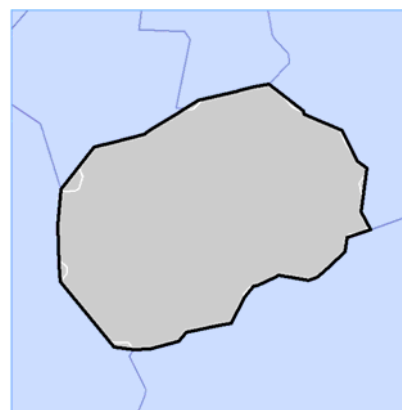
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	13
Gate-to-gate total costs (M€)	13
Gate-to-gate ATM/CNS provision costs (M€)	12
Gate-to-gate total ATM/CNS assets(M€)	7
Gate-to-gate ANS total capex (M€)	1
ATCOs in OPS	68
Gate-to-gate total staff (incl. MET staff*)	272
Total IFR flight-hours controlled by ANSP ('000)	24
IFR airport movements controlled by ANSP ('000)	17
En-route sectors open at maximum configuration	3
Minutes of ATFM delays ('000)	1

* if applicable

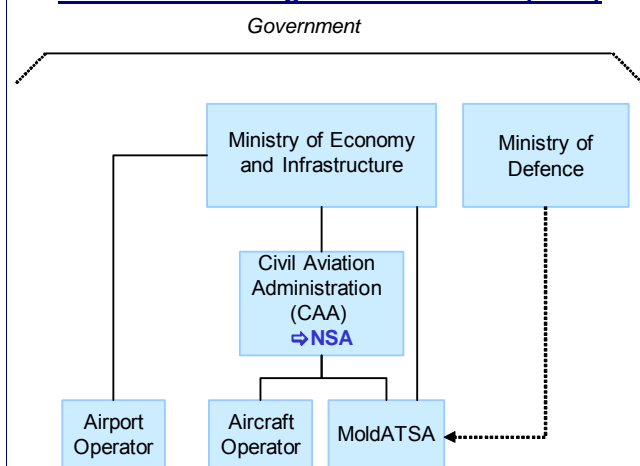
Size (2016)

Size of controlled airspace: 24 700 km²





Institutional arrangements and links (2018)



Status (2018)

- State enterprise since 1994 (by Government Regulation Nr.3 from 12.01.1994)
- 100% State-owned

National Supervisory Authority (NSA):

Civil Aviation Administration (CAA)

Body responsible for:

Safety Regulation

Ministry of Economy and Infrastructure

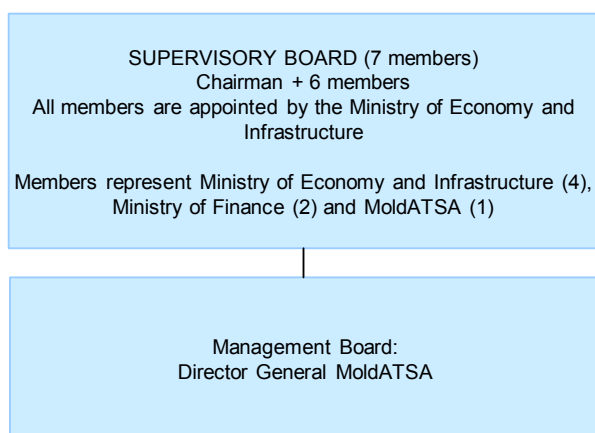
Airspace Regulation

Ministry of Economy and Infrastructure

Economic Regulation

Ministry of Economy and Infrastructure

Corporate governance structure (2018)



MoldATSA (2018)

CHAIRMAN OF THE SUPERVISORY BOARD:

Mr. Anatolie Usatii

DIRECTOR GENERAL (CEO):

Mr. Veaceslav Frunze

HEAD OF ATM DIVISION:

Mr. Eduard Ceabei

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

Operational ATS units (2016)

- 1 ACC (Chisinau)
- 1 APP (Chisinau)
- 4 TWRs (Chisinau, Balti, Cahul, Marculesti)

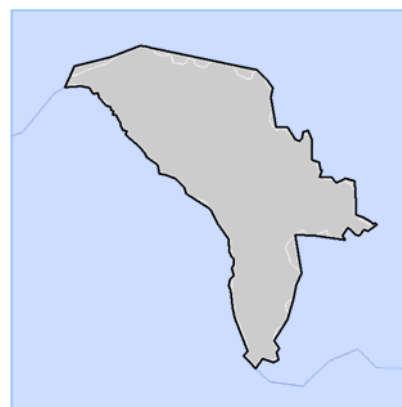
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	8
Gate-to-gate total costs (M€)	9
Gate-to-gate ATM/CNS provision costs (M€)	8
Gate-to-gate total ATM/CNS assets(M€)	5
Gate-to-gate ANS total capex (M€)	0
ATCOs in OPS	78
Gate-to-gate total staff (incl. MET staff*)	291
Total IFR flight-hours controlled by ANSP ('000)	9
IFR airport movements controlled by ANSP ('000)	22
En-route sectors open at maximum configuration	2
Minutes of ATFM delays ('000)	0

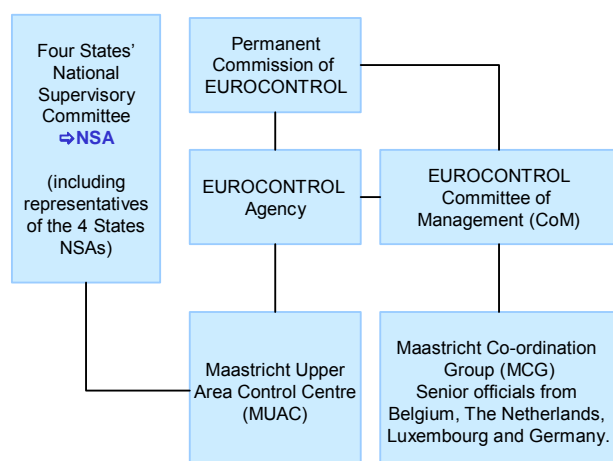
* if applicable

Size (2016)

Size of controlled airspace: 34 800 km²



Institutional arrangements and links (2018)



Status (2018)

- EUROCONTROL: International Organisation established under the EUROCONTROL Convention of 13.12.1960 and amended on 12.2.1981. At the request of the Benelux States and Germany, MUAC is operated as a EUROCONTROL Agency's Service according to the Maastricht Agreements of 25.11.1986

National Supervisory Authority (NSA):

Four States' National Supervisory Committee

Body responsible for:

Safety Regulation

Maastricht Agreements Art. 1.2: each of the 4 States retains its competence and obligations in respect of regulations

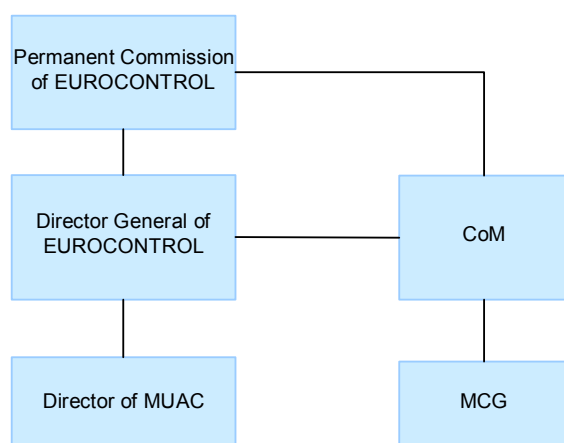
Airspace Regulation

The MCG determines a common position for the 4 States in all matters relating to the operation of ATS by MUAC concerning, inter alia, airspace organisation and sectorisation

Economic Regulation

Financial arrangements for the exploitation of MUAC are adopted by the Committee of Management. EUROCONTROL DG seeks approval of the budget, which contains a special budgetary Annex for MUAC, with the Permanent Commission

Corporate governance structure (2018)



MUAC (2018)

DIRECTOR GENERAL OF EUROCONTROL:

Eamonn Brennan

DIRECTOR OF MUAC:

John Santurbano

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- Controls GAT in the upper airspace (>FL245) above Benelux and North-Western Germany
- A German ATC unit responsible for handling OAT above North-Western Germany and managed by the DFS is co-located at MUAC

Operational ATS units (2016)

1 ACC (Maastricht)

Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	n/appl
Gate-to-gate total costs (M€)	143
Gate-to-gate ATM/CNS provision costs (M€)	143
Gate-to-gate total ATM/CNS assets(M€)	59
Gate-to-gate ANS total capex (M€)	3
ATCOs in OPS	267
Gate-to-gate total staff (incl. MET staff*)	569
Total IFR flight-hours controlled by ANSP ('000)	626
IFR airport movements controlled by ANSP ('000)	n/appl
En-route sectors open at maximum configuration	20
Minutes of ATFM delays ('000)	987

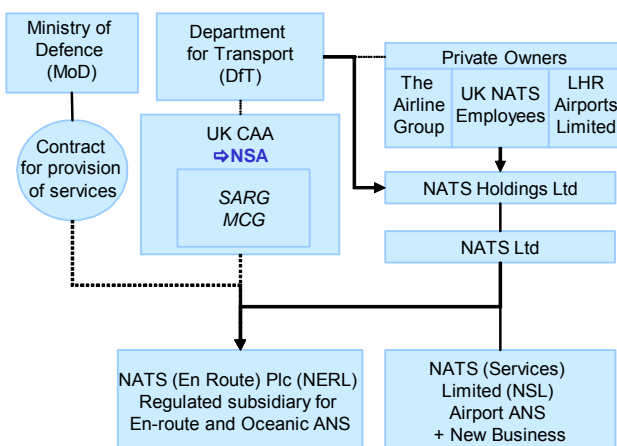
* if applicable

Size (2016)

Size of controlled airspace: 260 000 km²



Institutional arrangements and links (2018)



Status (2018)

- Public Private Partnership as of 2001
- 49% State-owned (Govt retains a Golden Share)
- 51% private-owned (42% by the Airline Group, 4% by LHR Airports Limited and 5% by UK NATS employees)
- The Airline Group comprises 6 airlines (BA, Virgin Atlantic, Lufthansa, EasyJet, Thomas Cook, Thomson Airways) and 2 pension funds (Pension Protection Fund and USS Sherwood Limited, which owns 49.9% of the Airline Group).

National Supervisory Authority (NSA):

UK CAA

Body responsible for:

Safety Regulation

UK CAA, Safety and Airspace Regulation Group (SARG)

Airspace Regulation

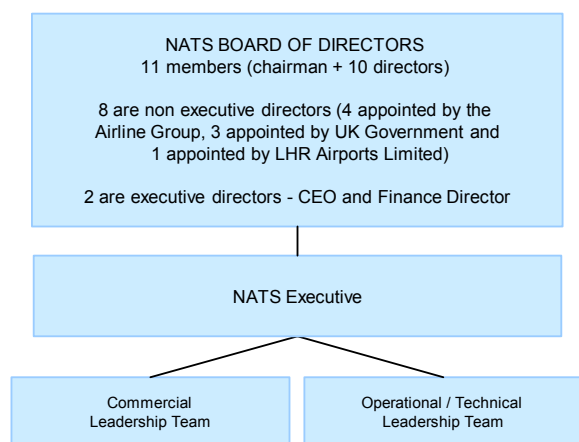
UK CAA, Safety and Airspace Regulation Group (SARG)

Economic Regulation

UK CAA, Markets and Consumers Group (MCG).

Charges control in RP2 linked to CPI (formerly RPI in CP3/RP1)

Corporate governance structure (2018)



NATS (2018)

CHAIRMAN OF THE NATS BOARD:

Paul Golby

CEO of NATS:

Martin Rolfe

OPERATIONS DIRECTOR:

Juliet Kennedy

COMMERCIAL DIRECTOR:

Guy Adams

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input checked="" type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

Operational ATS units (2016)

- 1 OAC (Shanwick)
- 3 ACCs (Swanwick AC, London TC, Prestwick AC)
- 16 APPs
- 16 TWRs (including Gibraltar TWR)
- 2 AFISs

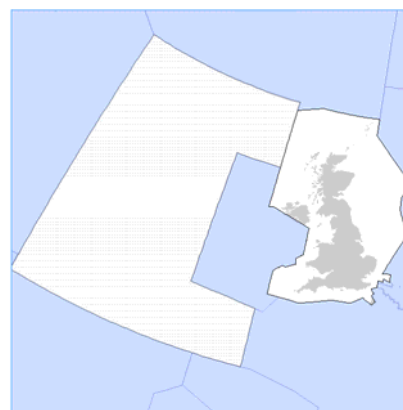
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	924
Gate-to-gate total costs (M€)	811
Gate-to-gate ATM/CNS provision costs (M€)	800
Gate-to-gate total ATM/CNS assets(M€)	1 018
Gate-to-gate ANS total capex (M€)	155
ATCOs in OPS	1 338
Gate-to-gate total staff (incl. MET staff*)	3 917
Total IFR flight-hours controlled by ANSP ('000)	1 423
IFR airport movements controlled by ANSP ('000)	1 595
En-route sectors open at maximum configuration	70
Minutes of ATFM delays ('000)	1 758

* if applicable

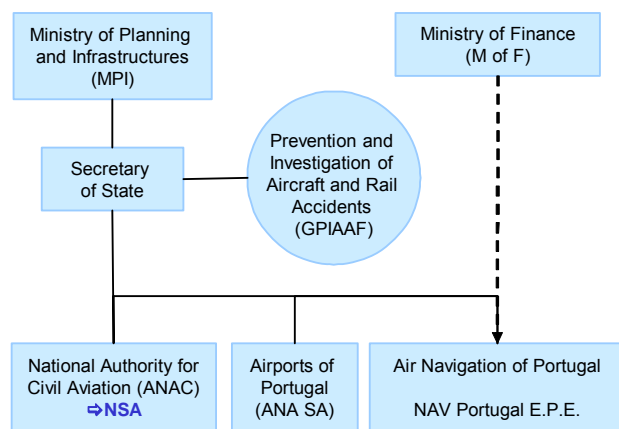
Size (2016)

Size of controlled airspace: 880 000 km²



Continental: 880 000 km² - Oceanic: 2 120 000 km²

Institutional arrangements and links (2018)



Status (2018)

- Public Entity Corporation as of December 1998
- 100% State-owned

National Supervisory Authority (NSA):

National Authority for Civil Aviation (ANAC)

Body responsible for:

Safety Regulation

National Authority for Civil Aviation (ANAC)

Airspace Regulation

ANAC+FA (Portuguese Air Force) + NAV Portugal in close permanent co-ordination

Economic Regulation

National Authority for Civil Aviation (ANAC)

Corporate governance structure (2018)

BOARD OF ADMINISTRATION (3 members)
Chairman + 2 member

All members are appointed by the Government for a 3 years term.
Each member has executive functions within NAV Portugal.
Each member is responsible to supervise several Directorates and Advisory Bodies to the Board.

There are 7 Directorates and 3 Advisory Bodies.

NAV Portugal has also a Board of Auditors composed of 3 members who are appointed by the Government for a 3 year term.

NAV Portugal (2018)

CHAIRMAN OF THE BOARD OF ADMINISTRATION:

Jorge Ponce de Leão

CEO:

Jorge Ponce de Leão

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input checked="" type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

Operational ATS units (2016)

2 ACCs (Lisboa, Santa Maria)
8 APPs (Lisboa, Porto, Faro, Madeira, Santa Maria, Ponta Delgada, Horta, Flores)
10 TWRs (Lisboa, Cascais, Porto, Faro, Funchal, Porto Santo, Ponta Delgada, Santa Maria, Horta, Flores)

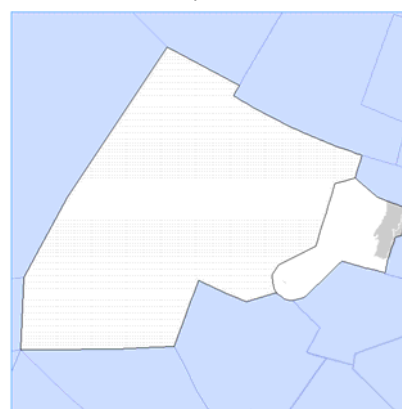
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	170
Gate-to-gate total costs (M€)	137
Gate-to-gate ATM/CNS provision costs (M€)	117
Gate-to-gate total ATM/CNS assets(M€)	45
Gate-to-gate ANS total capex (M€)	9
ATCOs in OPS	222
Gate-to-gate total staff (incl. MET staff*)	695
Total IFR flight-hours controlled by ANSP ('000)	374
IFR airport movements controlled by ANSP ('000)	347
En-route sectors open at maximum configuration	8
Minutes of ATFM delays ('000)	242

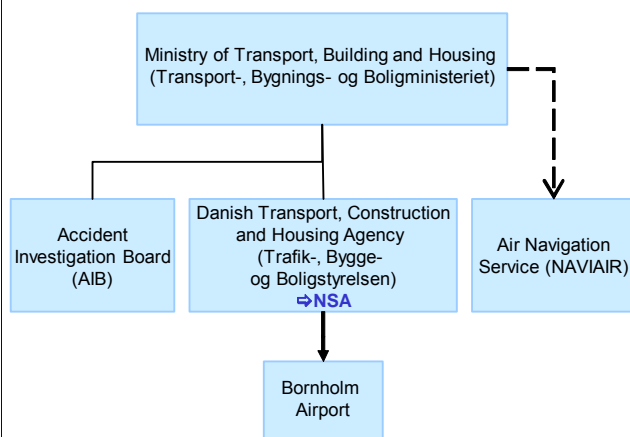
* if applicable

Size (2016)

Size of controlled airspace: 671 000 km²



Continental: 671 000 km² - Oceanic: 5 180 000 km²

Institutional arrangements and links (2018)

Status (2018)

- Company owned by the state
- 100% State-owned

National Supervisory Authority (NSA):

Danish Transport, Construction and Housing Agency (Trafik-, Bygge- og Boligstyrelsen)

Body responsible for:
Safety Regulation

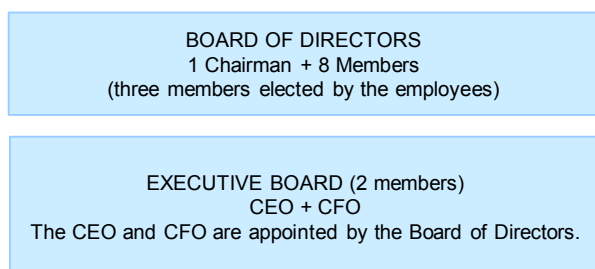
Danish Transport, Construction and Housing Agency (Trafik-, Bygge- og Boligstyrelsen)

Airspace Regulation

Danish Transport, Construction and Housing Agency (Trafik-, Bygge- og Boligstyrelsen)

Economic Regulation

Danish Transport, Construction and Housing Agency (Trafik-, Bygge- og Boligstyrelsen)

Corporate governance structure (2018)

NAVIAIR (2018)
CHAIRMAN OF BOARD OF DIRECTORS

Anne Birgitte Lundholt

CHIEF EXECUTIVE OFFICER (CEO):

Morten Dambæk

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

Note: ANS Greenland upper airspace is delegated to Isavia and NAV Canada

Operational ATS units (2016)

(Excluding Greenland)
 1 ACC (Copenhagen)
 6 APPs/TWRs (Kastrup, Roskilde, Rønne, Billund, Aarhus, Aalborg)
 1 APP co-located with ACC
 1 AFIS (Vagar)

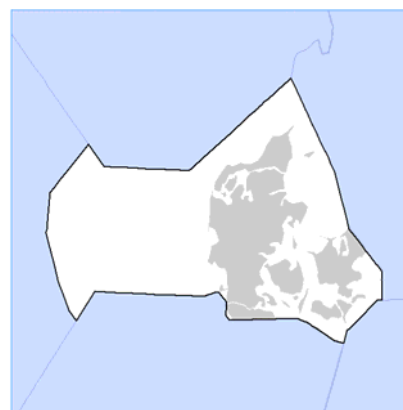
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	117
Gate-to-gate total costs (M€)	112
Gate-to-gate ATM/CNS provision costs (M€)	112
Gate-to-gate total ATM/CNS assets(M€)	142
Gate-to-gate ANS total capex (M€)	13
ATCOs in OPS	212
Gate-to-gate total staff (incl. MET staff*)	624
Total IFR flight-hours controlled by ANSP ('000)	218
IFR airport movements controlled by ANSP ('000)	352
En-route sectors open at maximum configuration	7
Minutes of ATFM delays ('000)	4

* if applicable

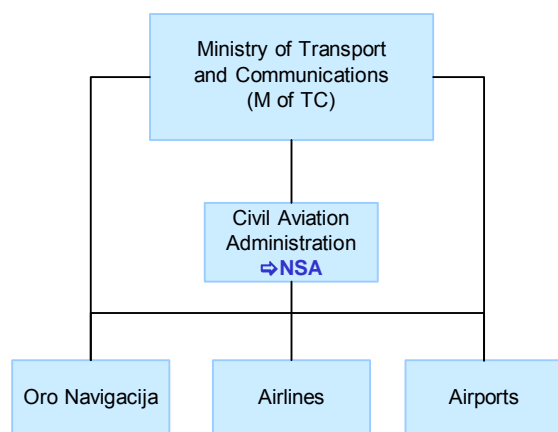
Size (2016)

Size of controlled airspace: 158 000 km²





Institutional arrangements and links (2018)



Status (2018)

- Since July 2001
- 100% State-owned Enterprise (SOE)

National Supervisory Authority (NSA):

Civil Aviation Administration

Body responsible for:

Safety Regulation

Lithuania CAA

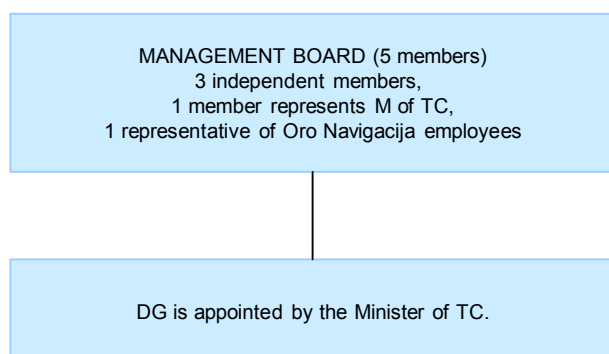
Airspace Regulation

Oro Navigacija in coordination with CAA and M of TC

Economic Regulation

Oro Navigacija in coordination with CAA and M of TC

Corporate governance structure (2018)



Oro Navigacija (2018)

CHAIRMAN OF THE MANAGEMENT BOARD:

Dangirutis Janušas (as of 15 February 2018)

DIRECTOR GENERAL (CEO):

Mindaugas Gustys

HEAD OF OPERATIONAL DEPARTMENT (ATM):

Nerijus Maleckas

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- Air Navigation Services are delegated to LGS (Latvia) above some part of the Baltic sea

Operational ATS units (2016)

1 ACC (Vilnius)
 4 APPs
 4 TWRs

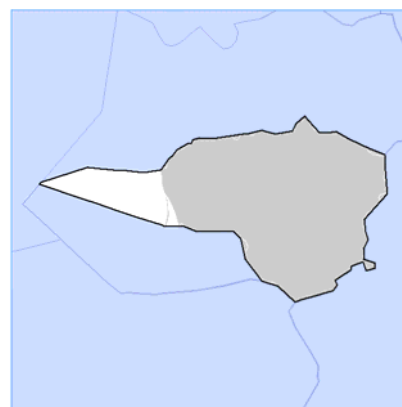
Key financial and operational figures (ACE 2016)

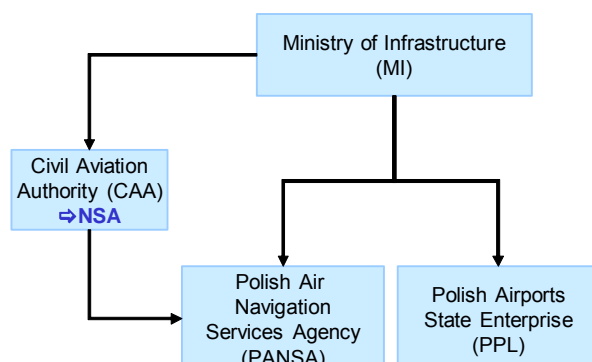
Gate-to-gate total revenues (M€)	29
Gate-to-gate total costs (M€)	28
Gate-to-gate ATM/CNS provision costs (M€)	26
Gate-to-gate total ATM/CNS assets(M€)	30
Gate-to-gate ANS total capex (M€)	9
ATCOs in OPS	82
Gate-to-gate total staff (incl. MET staff*)	292
Total IFR flight-hours controlled by ANSP ('000)	54
IFR airport movements controlled by ANSP ('000)	53
En-route sectors open at maximum configuration	3
Minutes of ATFM delays ('000)	0

* if applicable

Size (2016)

Size of controlled airspace: 74 700 km²




Institutional arrangements and links (2018)

Status (2018)

- PANSA has been operating as an independent entity as from 1st April 2007, separated from the Polish Airports State Enterprise (PPL)
- State body (acting as a legal entity with an autonomous budget)
- 100% State owned

National Supervisory Authority (NSA):

Civil Aviation Authority (CAA)

Body responsible for:
Safety Regulation

Civil Aviation Authority (CAA)

Airspace Regulation

Civil Aviation Authority (CAA)

Economic Regulation

Civil Aviation Authority (CAA)

Corporate governance structure (2018)

NO SUPERVISORY BOARD

ADMINISTRATION

According to the Act establishing PANSA, the Agency is managed by the President and his two Vice-Presidents. The President is nominated by the Prime Minister. The two Vice-Presidents are nominated by the MI

PANSA (2018)
PRESIDENT OF PANSA

Janusz Niedziela

VICE PRESIDENT OF AIR NAVIGATION

Tadeusz Grocholski

VICE PRESIDENT OF FINANCE AND ADMINISTRATION

Paweł Młynarczyk

Scope of services (2016)

- | | | |
|---|--|--------------------------------------|
| <input checked="" type="checkbox"/> GAT | <input checked="" type="checkbox"/> Upper Airspace | <input type="checkbox"/> Oceanic ANS |
| <input type="checkbox"/> OAT | <input checked="" type="checkbox"/> Lower Airspace | <input type="checkbox"/> MET |

- APP Kraków provides ATC services for Kraków and Katowice
- Katowice TWR provides aerodrome control
- APP Poznań provides ATC services for Poznań and Wrocław
- Wrocław TWR provides aerodrome control

Operational ATS units (2016)

- 1 ACC with 9 sectors (divided vertically (DFL365))
- 4 APPs (Warszawa, Gdańsk, Kraków, Poznań) providing radar control
- 7 TWRs (Warszawa Chopin and Modlin, Gdańsk, Kraków, Poznań, Katowice, Wrocław) providing aerodrome control
- 8 TWRs (Lublin, Szczecin, Rzeszów, Łódź, Zielona Góra, Bydgoszcz, Radom, Olsztyn) providing aerodrome control and non-radar approach control
- 4 FIS units (Warszawa, Kraków, Gdańsk, Poznań)

Key financial and operational figures (ACE 2016)

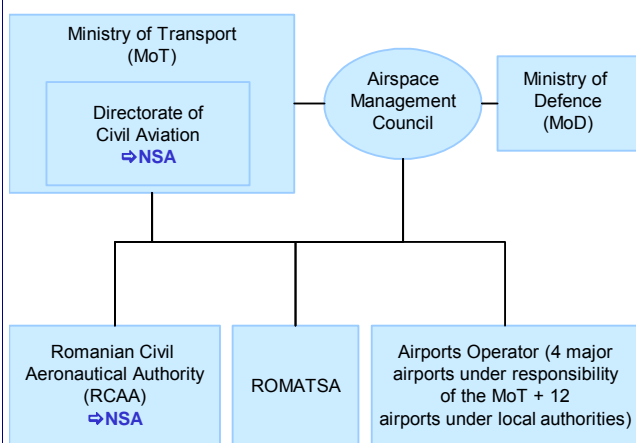
Gate-to-gate total revenues (M€)	174
Gate-to-gate total costs (M€)	181
Gate-to-gate ATM/CNS provision costs (M€)	159
Gate-to-gate total ATM/CNS assets(M€)	202
Gate-to-gate ANS total capex (M€)	40
ATCOs in OPS	510
Gate-to-gate total staff (incl. MET staff*)	1 797
Total IFR flight-hours controlled by ANSP ('000)	426
IFR airport movements controlled by ANSP ('000)	354
En-route sectors open at maximum configuration	11
Minutes of ATFM delays ('000)	333

* if applicable

Size (2016)

Size of controlled airspace: 334 000 km²



Institutional arrangements and links (2018)

Status (2018)

- Autonomous and self-financing organisation as of 1991 (Government Resolution GR74/1991 amended by GR731/1992, GR75/2005, GR1090/2006, GR1251/2007, GR741/2008)
- 100% State-owned

National Supervisory Authority (NSA):

- Directorate of Civil Aviation
- Romanian Civil Aeronautical Authority (RCAA)

Body responsible for:
Safety Regulation

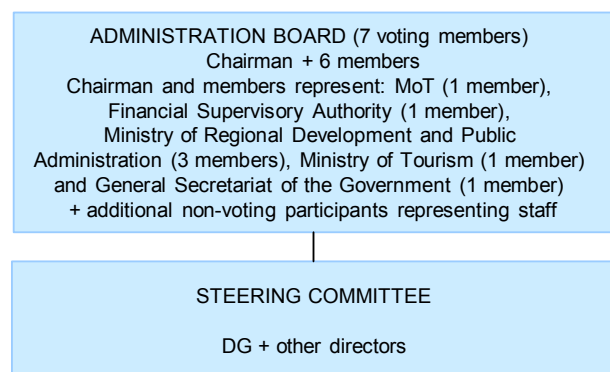
Ministry of Transport (MoT)
Enforcement and safety oversight is delegated and discharged through the RCAA

Airspace Regulation

Both Ministry of Transport (MoT) and Ministry of Defence (MoD), and discharged through the RCAA and Air Force Staff

Economic Regulation

Ministry of Transport (MoT)

Corporate governance structure (2018)

ROMATSA R.A. (2018)
CHAIRMAN OF THE ADMINISTRATION BOARD:

Marioara Nițu (temporary)

DIRECTOR GENERAL (CEO):

Valentin Cimpuiaru

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

Operational ATS units (2016)

1 ACC (Bucharest)
3 APPs
16 TWRs

Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	191
Gate-to-gate total costs (M€)	192
Gate-to-gate ATM/CNS provision costs (M€)	173
Gate-to-gate total ATM/CNS assets(M€)	100
Gate-to-gate ANS total capex (M€)	10
ATCOs in OPS	441
Gate-to-gate total staff (incl. MET staff*)	1 536
Total IFR flight-hours controlled by ANSP ('000)	339
IFR airport movements controlled by ANSP ('000)	173
En-route sectors open at maximum configuration	11
Minutes of ATFM delays ('000)	19

* if applicable

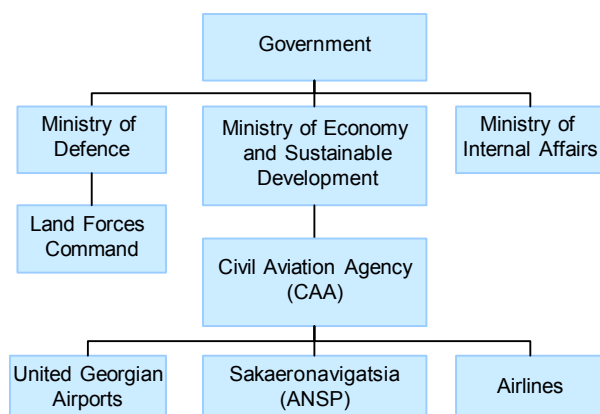
Size (2016)

Size of controlled airspace: 254 000 km²





Institutional arrangements and links (2018)



Status (2018)

- Limited liability company as of 1999
- 100% State owned

National Supervisory Authority (NSA):

Georgian Civil Aviation Agency (GCAA)

Body responsible for:

Safety Regulation

GCAA

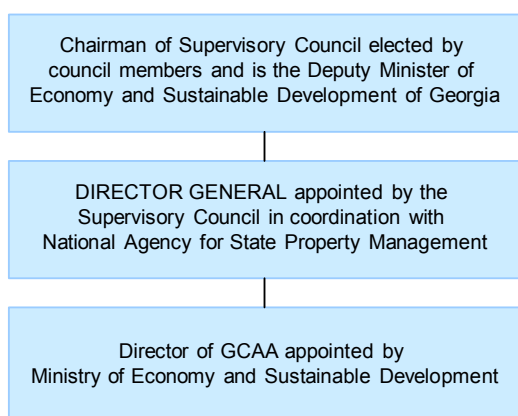
Airspace Regulation

President of Georgia

Economic Regulation

Ministry of Economy and Sustainable Development of Georgia

Corporate governance structure (2018)



Sakaeronavigatsia (2018)

CHAIRMAN OF THE SUPERVISORY BOARD:

Giorgi Cherqezishvili

DIRECTOR GENERAL AND CEO:

Gocha Mezvrishvili

HEAD OF THE ATS DEPARTMENT:

David Kadzanaia

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

Operational ATS units (2016)

- 1 ACC (Tbilisi)
- 3 TWRs (Tbilisi, Batumi, Kutaisi)
- 3 APPs co-located with ACCs (Tbilisi)
- 1 AFIS (Mestia)
- 1 AFIS (Ambrolauri)

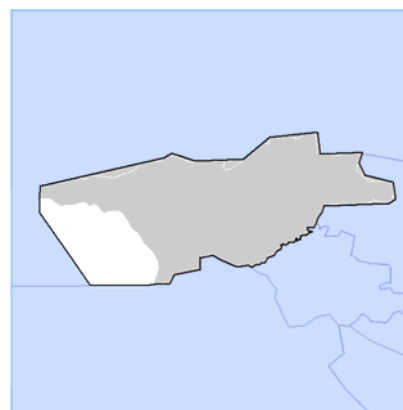
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	28
Gate-to-gate total costs (M€)	25
Gate-to-gate ATM/CNS provision costs (M€)	23
Gate-to-gate total ATM/CNS assets(M€)	41
Gate-to-gate ANS total capex (M€)	17
ATCOs in OPS	94
Gate-to-gate total staff (incl. MET staff*)	785
Total IFR flight-hours controlled by ANSP ('000)	51
IFR airport movements controlled by ANSP ('000)	30
En-route sectors open at maximum configuration	2
Minutes of ATFM delays ('000)	0

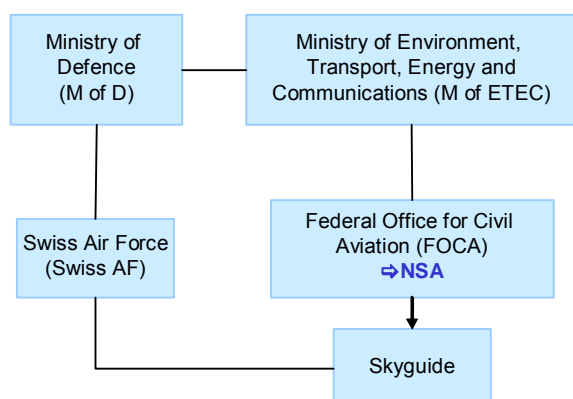
* if applicable

Size (2016)

Size of controlled airspace: 89 300 km²



Institutional arrangements and links (2018)



Status (2018)

- Joint-stock company as of 1996. Currently 14 shareholders; 99,94% is held by the Swiss Confederation which by law must hold at least 51%
- Integrated civil/military as of 2001

National Supervisory Authority (NSA):

Federal Office for Civil Aviation (FOCA)

Body responsible for:

Safety Regulation

Federal Office for Civil Aviation

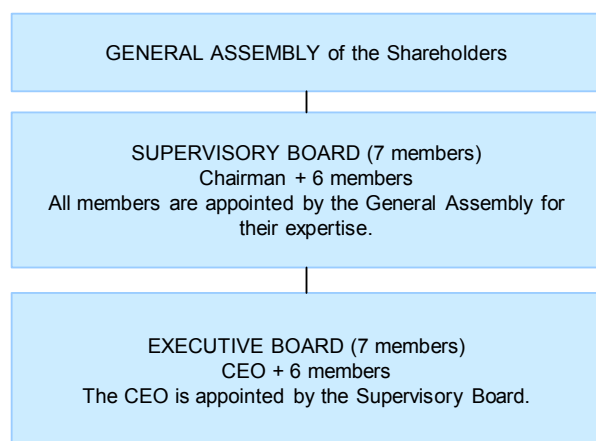
Airspace Regulation

Federal Office for Civil Aviation

Economic Regulation

The Ministry of the Environment, Transport, Energy and Communications

Corporate governance structure (2018)



Skyguide (2018)

CHAIRMAN OF THE SUPERVISORY BOARD:

Walter T. Vogel

DIRECTOR GENERAL (CEO):

Alex Bristol

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

- ATC services delegated to Geneva ACC by France

Operational ATS units (2016)

2 ACCs (Geneva, Zurich)
4 APPs (Geneva, Zurich, Lugano, Bern)
7 TWRs (Geneva, Zurich, Lugano, Bern, Buochs, Altenrhein, Grenchen)

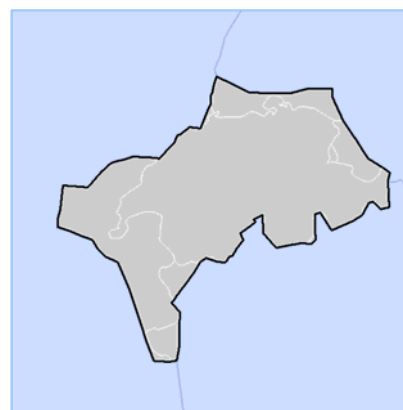
Key financial and operational figures (ACE 2016)

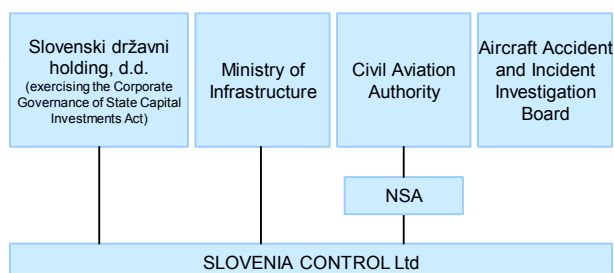
Gate-to-gate total revenues (M€)	369
Gate-to-gate total costs (M€)	344
Gate-to-gate ATM/CNS provision costs (M€)	317
Gate-to-gate total ATM/CNS assets (M€)	330
Gate-to-gate ANS total capex (M€)	56
ATCOs in OPS	359
Gate-to-gate total staff (incl. MET staff*)	1 310
Total IFR flight-hours controlled by ANSP ('000)	329
IFR airport movements controlled by ANSP ('000)	488
En-route sectors open at maximum configuration	19
Minutes of ATFM delays ('000)	516

* if applicable

Size (2016)

Size of controlled airspace: 69 700 km²



Institutional arrangements and links (2018)

Status (2018)

- Since 2004 the SLOVENIA CONTROL, Slovenian Air Navigation Services, Ltd, as a 100% state-owned enterprise is independent of national supervisory authorities.

National Supervisory Authority (NSA):

Civil Aviation Authority

Body responsible for:
Safety Regulation

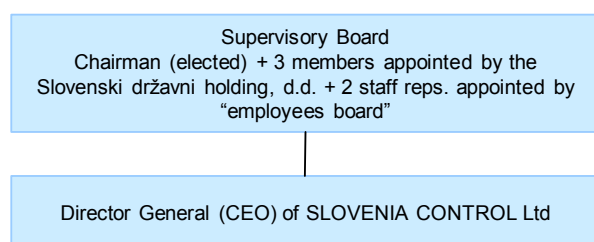
Ministry of Infrastructure and Spatial Planning

Airspace Regulation

Ministry of Infrastructure and Spatial Planning

Economic Regulation

Slovenski državni holding, d.d. (SDH), exercising the Corporate Governance of State Capital Investments Act

Corporate governance structure (2018)

Slovenia Control (2018)
CHAIRMAN OF THE SUPERVISORY BOARD:

Dušan Hočevar

DIRECTOR GENERAL (CEO):

Franc Željko Županič, Ph.D.

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input type="checkbox"/> MET

Operational ATS units (2016)

1 ACC (Ljubljana)
3 APPs (Ljubljana, Maribor, Portorož)
3 TWRs (Ljubljana, Maribor, Portorož)

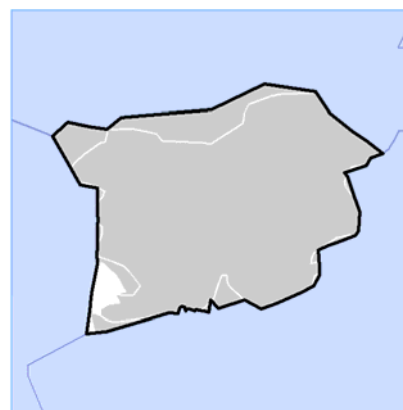
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	38
Gate-to-gate total costs (M€)	37
Gate-to-gate ATM/CNS provision costs (M€)	32
Gate-to-gate total ATM/CNS assets(M€)	30
Gate-to-gate ANS total capex (M€)	1
ATCOs in OPS	90
Gate-to-gate total staff (incl. MET staff*)	221
Total IFR flight-hours controlled by ANSP ('000)	51
IFR airport movements controlled by ANSP ('000)	30
En-route sectors open at maximum configuration	4
Minutes of ATFM delays ('000)	4

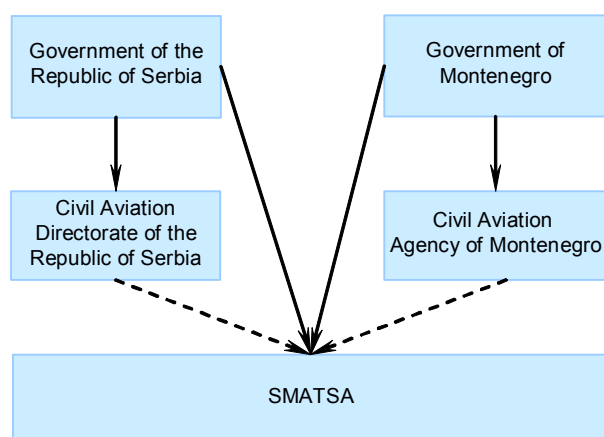
* if applicable

Size (2016)

Size of controlled airspace: 20 400 km²



Institutional arrangements and links (2018)



Status (2018)

- Limited liability company founded in 2003
- 92% owned by Serbia and 8% owned by Montenegro
- Integrated civil/military ANSP

National Supervisory Authority (NSA):

- Civil Aviation Directorate of the Republic of Serbia
- Civil Aviation Agency of Montenegro

Body responsible for:

Safety Regulation

- Civil Aviation Directorate of the Republic of Serbia
- Civil Aviation Agency of Montenegro

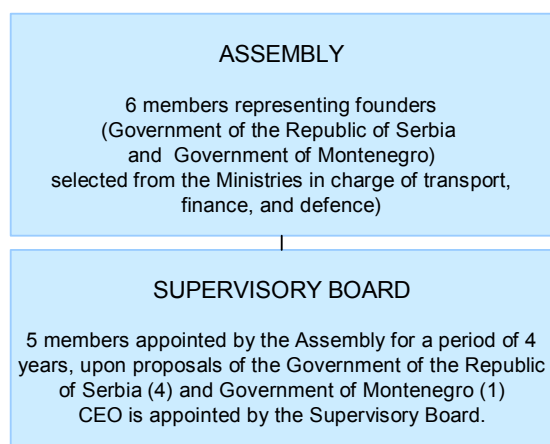
Airspace Regulation

- Civil Aviation Directorate of the Republic of Serbia
- Civil Aviation Agency of Montenegro

Economic Regulation

Ministry of Finance of the Republic of Serbia

Corporate governance structure (2018)



SMATSA (2018)

PRESIDENT OF THE ASSEMBLY:

Zoran Kostić

PRESIDENT OF THE SUPERVISORY BOARD:

Dejan Mandić

CEO:

Predrag Jovanović

Scope of services (2016)

<input checked="" type="checkbox"/> GAT	<input checked="" type="checkbox"/> Upper Airspace	<input type="checkbox"/> Oceanic ANS
<input checked="" type="checkbox"/> OAT	<input checked="" type="checkbox"/> Lower Airspace	<input checked="" type="checkbox"/> MET

- ANS Services (ATM, CNS, MET, AIS)
- SMATSA provides Air Traffic Services in the 55% of the upper airspace of Bosnia and Herzegovina
- ANS personnel and pilot training, Flight Inspection Services, PANS-OPS and cartography

Operational ATS units (2016)

- 1 ACC (Belgrade)
- 1 APP collocated with ACC Belgrade
- 7 APPs/TWRs (Batajnica, Kraljevo, Nis, Vrsac, Podgorica, Tivat, Uzice)
- 1 TWR (Belgrade)

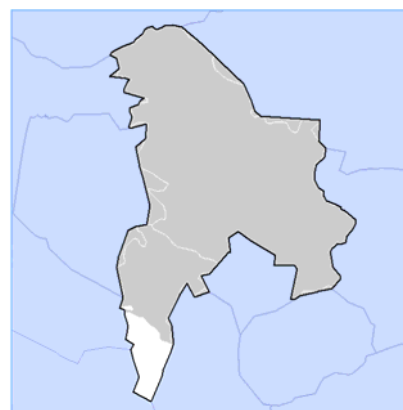
Key financial and operational figures (ACE 2016)

Gate-to-gate total revenues (M€)	83
Gate-to-gate total costs (M€)	81
Gate-to-gate ATM/CNS provision costs (M€)	73
Gate-to-gate total ATM/CNS assets(M€)	86
Gate-to-gate ANS total capex (M€)	13
ATCOs in OPS	268
Gate-to-gate total staff (incl. MET staff*)	875
Total IFR flight-hours controlled by ANSP ('000)	236
IFR airport movements controlled by ANSP ('000)	87
En-route sectors open at maximum configuration	9
Minutes of ATFM delays ('000)	5

* if applicable

Size (2016)

Size of controlled airspace: 129 000 km²



GLOSSARY

ACC	Area Control Centre
ACE	Air Traffic Management Cost-Effectiveness
ADS-B	Automatic Dependent Surveillance-Broadcast
AFIS	Airport/Aerodrome Flight Information Service
AIS	Aeronautical Information Services
Albcontrol	National Air Traffic Agency, Albania
ANS	Air Navigation Services
ANS CR	Air Navigation Services of the Czech Republic
ANSP	Air Navigation Service Provider
APP	Approach Control Unit
ARMATS	Armenian Air Traffic Services
A-SMGCS	Advanced Surface Movement Guidance and Control System
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATFM	Air Traffic Flow Management
ATIS	Automatic terminal information service
ATM	Air Traffic Management
Austro Control	Austro Control Österreichische Gesellschaft für Zivilluftfahrt mbH, Austria
Avinor	Avinor Flysikring AS, Norway
B	Billion
Belgocontrol	Belgocontrol, Belgium
BULATSA	Bulgarian Air Traffic Services Authority
CAPEX	Capital Expenditure
CNS	Communications, Navigation and Surveillance
COOPANS	Industrial partnership between 5 ANSPs (Austro Control, Croatia Control, IAA, LFV and NAVIAIR)
CPDLC	Controller Pilot Data Link Communications
CRCO	Central Route Charges Office
Croatia Control	Hrvatska kontrola zračne plovidbe d.o.o., Croatian Air Navigation Services
DCAC Cyprus	Department of Civil Aviation of Cyprus
DFS	Deutsche Flugsicherung GmbH, Germany
DHMI	Devlet Hava Meydanları İşletmesi, Turkey
DME	Distance-Measuring Equipment
DSNA	Direction des services de la navigation aérienne, France
EANS	Estonian Air Navigation Services
EC	European Commission
ECAC	European Civil Aviation Conference
ENAIRE	Air Navigation Service Provider of Spain
ENAV	Ente Nazionale di Assistenza al Volo S.p.A., Italy
ERC	EUROCONTROL Research Centre
ETS	Early Termination of Service
EU	European Union
FAB	Functional Airspace Block
FDP	Flight Data Processing system
Finavia	Finavia, Finland (ANS Finland as of April 2017)
FIR	Flight Information Region

FIS	Flight Information Service
FL	Flight Level
FTE	Full-Time Equivalent
FUA	Flexible Use of Airspace
GBAS	Ground Based Augmentation System
GDP	Gross Domestic Product
HCAA	Hellenic Civil Aviation Authority, Greece
HMI	Human-Machine Interface
HQ	Headquarters
HungaroControl	Hungarian Air Navigation Services, Hungary
IAA	Irish Aviation Authority, Ireland
IFR	Instrument Flight Rules
IFRS	International Financial Reporting Standards
ILS	Instrument Landing System
iTEC	"interoperability Through European Collaboration", an industrial alliance between 7 ANSPs (Avinor, DFS, ENAIRE, LVNL, NATS, Oro Navigacija and PANSA) and one ATM system supplier (INDRA)
LFV	Luftfartsverket, Sweden
LGS	Latvijas Gaisa Satiksme, Latvia
LPS	Letové Prevádzkové Služby Slovenskej Republiky, Státny Podnik, Slovak Republik
LVNL	Luchtverkeersleiding Nederland, Netherlands
M	Million
MATS	Malta Air Traffic Services Ltd
MET	Aeronautical Meteorology
MLAT	Multilateration
M-NAV	Air Navigation Services Provider of the former Yugoslav Republic of Macedonia
MoldATSA	Moldavian Air Traffic Services Authority
MSSR	Monopulse Secondary Surveillance Radar
MTCD	Medium-Term Conflict Detection
MUAC	Maastricht Upper Area Control Centre
NATS	National Air Traffic Services, United Kingdom
NAV Portugal	Navegação Aérea de Portugal – NAV Portugal, EPE
NAVIAIR	Air Navigation Services – Flyvesikringstjenesten, Denmark
NBV	Net Book Value
NDB	Non-Directional Beacon
NM	EUROCONTROL Network Manager
NSA	National Supervisory Authority
OAT	Operational air traffic
ODS	Operational Display System
OPS	Operations
Oro Navigacija	State Enterprise Oro Navigacija, Lithuania
PANSA	Polish Air Navigation Services Agency
PBN	Performance-based navigation
PCP	Pilot Common Project
PPPs	Purchasing power parities
PRB	Performance Review Body
PRC	Performance Review Commission
P-RNAV	Precision-Area Navigation
PRR	Performance Review Report

PRU	Performance Review Unit
PSR	Primary Surveillance Radar
RDP	Radar Data Processing system
ROMATSA	Romanian Air Traffic Services Administration
RP1	Reference Period 1 (2012 – 2014)
RP2	Reference Period 2 (2015 – 2019)
RPI	Retail Price Index
Sakaeronavigatsia	SAKAERONAVIGATSIA Ltd., Georgia
SAR	Search and Rescue
SEID	Specification for Economic Information Disclosure
SES	Single European Sky
SESAR IP1	Single European Sky ATM Research Implementation Package 1
Skyguide	Skyguide, Switzerland
Slovenia Control	SLOVENIA CONTROL Ltd, Slovenia
SMATSA	Serbia and Montenegro Air Traffic Services Agency
SMR	Surface movement radar
SSR	Secondary surveillance radar
TC	Terminal Control
TWR	Traffic Controlled Tower
UK CAA	United Kingdom Civil Aviation Authority
UkSATSE	Ukrainian State Air Traffic Service Enterprise
VCSS	Voice Communication Switching System
VFR	Visual Flight Rules
VoIP	Voice over Internet Protocol
VOR	Very high frequency Omni-directional Range
WAM	Wide Area Multilateration

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Printed by EUROCONTROL 96, rue de la Fusée, B-1130 Brussels, Belgium. Tel: +32 2 729 3956. Fax: +32 2 729 9108.