ESESA EGNOS Service Extension to South Africa

EGNOS benefits for regional airlines

ESESA Aviation Workshop 26th – 27th October 2010

ESESA is a project co-funded by the EU 7th FP and South Africa

Business case for AIR NOSTRUM SBAS equippage

- Air Nostrum is a Spanish regional airline
- LPV (Lateral approaches with vertical guidance) could benefit Air Nostrum (ANS) at a number of airports that they fly into with NPAs
- Carried out an analysis of the benefits to ANS to equip with SBAS to fly LPV
- Dominant aircraft of ANS is the CRJ200 equipped with a Collins FMS 4200
- The costs of implementing APV will be € 40 k per aircraft, or a total of € 2.6 M for their fleet
- Safety and environmental benefits identified but not quantified

Total number of accidents related to NPAs	29
Number of NPA accidents during poor weather / low minima	16
Accidents during ILS outages / unavailability	3

Table 6-1: NPA accident summary

ANS costs

Item	Cost
Modification of both FMS on each aircraft	€ 15 700
Modification of Input Output Concentrators	€ 9 420
Software upgrade for the GPS receiver	€ 3 925
Installation of equipment	€ 510
Training costs	€ 11,430
Total per aircraft	€ 40 985

Table 3-1: Costs per aircraft

Cost per aircraft	Number	Total Cost
Airborne costs (€ 40 985)	63	€ 2.6 M
	Total	€ 2.6 M

Table 3-2: Summary of costs

Spanish airports that would benefit from APV

Airport	Reason for Benefit from LPV
El Hierro RWY 16/34	Airports in which no runways are equipped with ILS and no ILS is expected to be set up.
La Palma RWY 01	
Logroño RWY 11/29	
Melilla RWY 15	
San Sebastián RWY 04/22	
La Coruña RWY 04	Airports where setting up an ILS is not feasible due to a negative cost-benefit analysis.
Alicante RWY 28	
Gerona RWY 02	
Asturias RWY 11	
Almería RWY 08	Airports with runways equipped with an ILS in one direction only.
Badajoz RWY 13	
Granada RWY 27	
Jerez RWY 03	
León RWY 05	
Murcia/San Javier RWY23	
Palma de Mallorca RWY 06R	
Pamplona RWY 33	
Reus RWY 07	
Salamanca RWY 03	
Santander RWY 11	
Valladolid RWY 05	
Vitoria RWY 22	
Zaragoza RWY 12R/30L/12L	

Table 2-1: Runways identified by Aena that would benefit from LPV

Top 20 airports for ANS

ICAO code	Name	Estimated ANS landings in 2006 *	Benefit expected from LPV
LEMD	Madrid (MAD - Barajas)	27 822	
LEBL	Barcelona (BCN - El Prat)	14 895	
LEVC	Valencia (VLC - Manises)	11 859	
LEPA	Palma de Mallorca (PMI - Son San Juan)	8 712	✓
LEBB	Bilbao (BIO - Sondika)	6 351	
LEMG	Málaga (AGP - Pablo Ruíz Picasso)	4 946	
LEIB	Ibiza (IBZ - Es Codolá)	4 553	
LEXJ	Santander - Cantabria (SDR - Parayas)	3 316	✓
LEMH	Menorca (MAH - Mahón)	4 047	
GEML	Melilla (MLN)	3 991	✓
LEAM	Almería (LEI)	3 597	✓
LEZL	Sevilla (SVQ - San Pablo)	3 429	
LEPP	Pamplona (PNA - Noaín)	2 979	✓
LESO	San Sebastián - Donosti (EAS - Fuenterrabía)	2 248	✓
LFMN	Nice (NCE - Cote D'Azur)	2 473	✓
LEST	Santiago de Compostela (SCQ)	2 585	
LEAL	Alicante (ALC - El Altet)	2 248	✓
LIMF	Turín - Torino (TRN - Caselle)	1 911	
LIPE	Bolonia - Bologne (BLQ - Guglielmo Marconi)	1 799	
LPPR	Oporto - Porto (OPO - Francisco Sá Carneiro)	1 630	
* Estimate by Helios from European traffic data			

Table 2-3: Top 20 destinations for ANS

DDCs – Category C aircraft only

ICAO Code	Name	Total landings (2006)	Total NPAs (2006)	Total diverions (2006)	Diversions expected to be avoided per year	Total hours LPV would benefit per year
LEAB	Albacete (ABC - Los Llanos)	506	0	0	0	63
LEAL	Alicante (ALC - El Altet)	2,248	279	1	0	24
LEAM	Almería (LEI)	3,597	154	4	3	328
LEAS	Asturias (OVD - Oviedo)	1,012	254	8	4	146
LEBZ	Badajoz (BJZ - Talavera La Real)	562	0	0	0	289
LEBL	Barcelona (BCN - El Prat)	11,073	0	0	0	0
LFSB	Basilea - Basel/Mulhouse (BSL - EuroAirport)	337	66	21	18	2,184
LEBB	Bilbao (BIO - Sondika)	6,351	848	141	134	1,683
LIPE	Bolonia - Bologne (BLQ - Guglielmo Marconi)	1,799	342	94	68	1,090
EBBR	Bruselas - Brussels (BRU - Brussels National)	225	0	0	0	0
LFBD	Burdeos - Bordeaux (BOD - Merignac)	0	0	0	0	231
LIEE	Cagliari (CAG - Elmas)	0	0	0	0	122
GMMN	Casablanca - Marruecos (CMN - Mohammed V Intl)	0	0	0	0	0
LFST	Estrasburgo - Strasbourg (SXB - Entzineim)	618	12	0	0	186
EDDF	Frankfurt (FRA - Frankfurt International)	281	0	0	0	0
LSGG	Ginebra - Geneva (GVA - Cointrin)	506	10	0	0	221
GCLP	Gran Canaria (LPA - Gando)	0	0	0	0	0
LEGR	Granada (GRX)	337	0	0	0	175
EDDV	Hannover - Hanover (HAJ - Hannover)	1,180	0	0	0	0
LEIB	Ibiza (IBZ - Es Codolá)	4,553	0	0	0	39
LECO	La Coruña - A Coruña (LCG - El Alvedro)	337	0	0	0	287
LERJ	La Rioja - Logroño (RJL - Agoncillo)	731	0	0	0	0
GCRR	Lanzarote (ACE) Sevilla (SVQ - San Pablo)	0	0	0	0	0

LELN	León (LEN - Virgen del Camino)	0	0	0	0	20
LPPT	Lisboa-Portugal (LIS - Portela de Sacavem)	0	0	0	0	173
EGKK	Londres - London (LGW - Gatwick) Menorca (MAH - Mahón)	169	3	0	0	347
LFLL	Lyon (LYS - Satolas)	1,180	0	0	0	0
LEMD	Madrid (MAD - Barajas)	25,237	0	0	0	0
LEMG	Málaga (AGP - Pablo Ruíz Picasso)	4,946	28	1	1	345
LFML	Marsella - Marseille (MRS - Marignane)	1,293	26	0	0	25
GEML	Melilla (MLN)	3,991	0	0	0	0
LEMH	Menorca (MAH - Mahón)	4,047	0	0	0	64
LIMC	Milán - Milano (MXP - Malpensa)	0	0	0	0	0
LELC	Murcia (MJV - San Javier)	393	91	1	0	40
LIRN	Nápoles - Naples - Napoli (NAP - Capodichino)	0	0	0	0	2,630
LFMN	Niza - Nice (NCE - Cote D'Azur)	2,473	451	20	17	387
LPPR	Oporto - Porto (OPO - Francisco Sá Carneiro)	1,293	172	11	7	458
LEPA	Palma de Mallorca (PMI - Son San Juan) Asturias (OVD - Oviedo)	8,712	0	0	0	0
LEPP	Pamplona (PNA - Noaín)	2,979	0	0	0	629
LFPG	Paris (CDG - Charles De Gaulle)	0	0	0	0	0
LFPO	Paris (ORY - Orly)	1,068	0	0	0	0
LIRP	Pisa (PSA - Galileo Galilei)	674	130	4	2	604
LERS	Reus (REU)	562	0	0	0	61
LESO	San Sebastián - Donosti (EAS - Fuenterrabía)	2,248	0	0	0	428
LEXJ	Santander - Cantabria (SDR - Parayas)	3,316	221	17	15	552
LEST	Santiago de Compostela (SCQ)	2,585	33	3	2	311
LEZL	Sevilla (SVQ - San Pablo)	3,429	723	49	37	317
GCXO	Tenerife Norte (TFN - Los Rodeos)	0	0	0	0	0
LFBO	Toulouse (TLS - Blagnac)	787	0	0	0	0
LIMF	Turín - Torino (TRN - Caselle)	1,574	304	47	33	805
LEVC	Valencia (VLC - Manises)	11,691	836	68	62*	993
LEVD	Valladolid (VLL - Villanubla)	1,012	310	15	5	96
LIPX	Verona (VRN)	0	0	0	0	1,777
LEVX	Vigo - Pontevedra (VGO - Peinador)	393	54	9	7	1,097
LEVT	Vitoria - Alava (VIT)	337	11	1	0	696
LEZG	Zaragoza (ZAZ)	562	107	1	0	159
LSZH	Zurich (ZRH - Kloten)	393	0	0	0	0
		123,597		**514**	**417**	**20,077**

* Due to the expected introduction of an ILS system to Valencia airport this value is assumed to be zero from 2010 onwards, as the ILS will be used in preference LPV.

Overall ANS result

- Benefits accrued due to avoided disruptions (DDCs)
- Net benefit for ANS is € 9 M over 10 years
- Breakeven would be achieved after 2 years

> The analysis shows that of the estimated 124 000 landings conducted by ANS per year, there would be 730 occasions (0.6% of landings) when a disruption would be avoided because of the lower minima offered by LPV. This equates to a financial benefit of around € 2 M per year. After 2010, the number of disruptions avoided to LPV is estimated to drop to 622, due to the introduction of an ILS system at Valencia airport.
>
> The calculated net benefit (ie cumulative benefits – costs) of implementing LPV is therefore € 9 M PV[4] over a ten year period from 2007. The project would breakeven in 2009.

- Cost of equipping for Baro-VNAV was the same but benefits were reduced since only 28 disruptions/year would be prevented
  - ✓ NPV = - €2.1 M

Czech Airlines (CSA) study

RNAV approaches

If there is another approach (satellite based) with lower minima, it can significantly reduce diverts and flight cancellations due to poor weather conditions

CSA has 69 scheduled and 49 charter destinations which of them are:

- 57 LVO (ILS CAT II or III) equipped
- 47 ILS CAT I equipped
- 14 only non-precision approach

CSA has 80 000 flights schedulled a year

Czech Airlines' view

Cost saving

We have approximately

- 240 flights diverted (0,3%) a year and half of them (120) due to weather conditions
- 560 cancelled flights (0,7%) a year and half of them (280) due to weather conditions

Financial costs

- EUR 4,100 per one divert, which is EUR 492,000 for 120 flights
- EUR 26,460 per one cancelled flight, which is EUR 7,408,800 for 280 flights

Improving (lowering) the required minima for landing can save a lot of money by reducing the number of diverts or cancelled flights. Even a small number of flights can save a relatively great money.

Conclusions

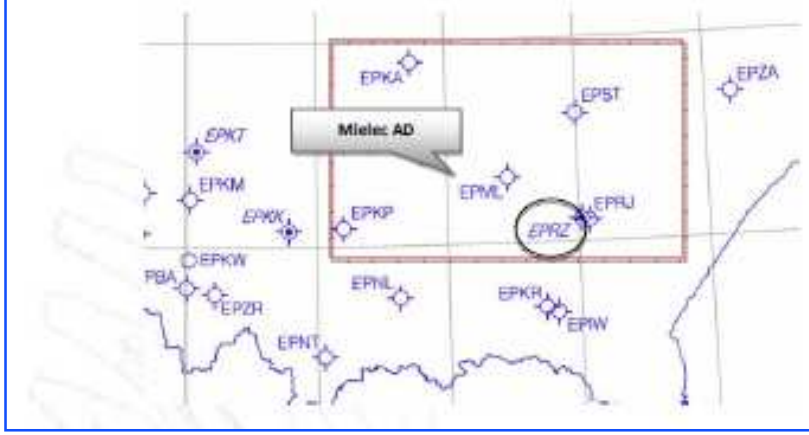
- Some examples of bottom-up cost benefit analyses
- Outcome is crucially dependent on local parameters
  - ✓ Existing navaids
  - ✓ Fleet and equippage of users
  - ✓ Local airport landing fees
  - ✓ Local weather and geography (DDC reduction, advantages of curved approaches)
- The ESESA top down approach to the CBA should be complemented with bottom up analysis for individual airports in South Africa and SADC

Polish study – MIELEC AD

- Runway Characteristics:

RWY	TORA (M)	TODA (M)	ASDA (M)	LDA (M)
09	2498	2498	2498	2310
27	2498	2498	2498	2498

- Nearest airports:



Rzeszow AD (EPRZ) is the biggest airport in the area around Mielec. It has an important infrastructure, both airside and landside which will gain the passenger of the surrounding area.

For the time being, Mielec IFR FTOs has benefited of Rzeszow AD, using this airport to carry out instrumental approaches based on the ILS installed in RWY27

Polish study – MIELEC AD result

Parameter	Baseline	Scenario A	Scenario B	Scenario C
# of disrupted approaches (in 2015)	between 2265 and 2777	between 1495 and 1833	between 917 and 1125	residual
# of new operations enabled with RNAV approaches (in 2015)	none	between 770 and 944	between 1348 and 1652	between 2265 and 2777
CBA [EUR]				
Investment needed [EUR]	N/A	28800	28800	57600
Discount rate		10%		
NPV (AD/ users) [EUR]		-17250 / -6000	-8500 / 11250	-23500 / 9500
IRR (AD / users) [%]		- / 2%	4% / 23%	1% / 16%
Comments		Investment not recommended	Investment only recommended on users side	Investment only recommended on users side

- In any case, the investment to introduce RNAV approaches in Mielec **is not profitable on the Airport's side**
- There are two possible ways to justify the investment for the implementation of LPV approaches in Mielec:
  - **Co-shared investment** involving both the airport and the users
  - Airport **charges increase**
- The fast is the implementation of SBAS capable equipment on behalf of the users, sooner is the return of investment
- CBA only considers purely direct economic costs (economical regional development, airport areas business,...etc)

- Overall result for Mielec AD is negative but this is due to very low airport fees under a current special agreement

Extra slides

ATI (operator) analysis - Airport 1

Clermont Ferrand analysis

Baseline Situation			
Annual number of disruptions	11		
Annual cost of disruptions (€)	51 260		
Annual cost of ILS maintenance (€)	17 600		
Runway end LFLC26 – Estimated annual number of disruptions per scenario			
Approach type	**Scen 1 (LNAV)**	**Scen 2 (APV SBAS)**	**Scen 3 (APV Baro)**
Annual number of disruptions	11	6	11
Runway end LFLC26 – Estimated annual number of disruptions per scenario			
Approach combination	**Scen4 (LNAV+APV SBAS)**	**Scen 5 (LNAV+APV Baro)**	**Scen 6 (LNAV+SBAS+APV Baro)**
Annual number of disruptions	7	11	6

Airport 2

Saint Nazaire Analysis

Runway end LFRZ26 - Baseline Situation			
Annual number of disruptions	14		
Annual cost of disruptions (€)	65 240		
Annual cost of iLS maintenance (€)	27 600		
Runway end LFRZ26 (ILS QFU) – Estimated number of disruptions per approach type			
Approach type	**Scen 1 (LNAV)**	**Scen 2 (APV SBAS)**	**Scen 3 (APV Baro)**
Annual number of disruptions	3	5	13
Runway end LFRZ26 (ILS QFU)– Estimated number of disruptions per approach combination			
Approach combination	**Scen 4 (LNAV+ APV SBAS)**	**Scen 5 (LNAV + APV Baro)**	**Scen 6 (LNAV+ APV SBAS+ APV Baro)**
Annual number of disruptions	3	3	3

Airport 3

Pau Analysis

Baseline Situation			
Annual number of disruptions	22		
Annual cost of disruptions (€)	102 520		
Annual cost of ILS maintenance (€)	17 600		
Runway end LFBP31 – Estimated number of disruptions per approach type			
Approach type	**Scen 1 (LNAV)**	**Scen 2 (APV SBAS)**	**Scen 3 (APV Baro)**
Annual number of disruptions	16	17	15
Runway end LFBP31 – Estimated number of disruptions per approach combination			
Approach combination	**Scen 4 (LNAV+ APV SBAS)**	**Scen 5 (LNAV + APV Baro)**	**Scen 6 (LNAV+ APV SBAS+ APV Baro)**
Annual number of disruptions	13	12	10

Airbus modifications

- Beluga A300-600ST modifications to integrate LPV capability:
  - Active SBAS antenna installation
  - Installation of SBAS capable receiver (GLSSU)
  - Addition of two control panels specific to LPV
  - Navigation Display modification
- Update of ATI's documentation impacted by SBAS introduction (Update of Installation instructions, of Flight Manual, etc) until STC delivery