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TIME MODIFICATION OF AIRPORT OPERATION AND ENVIRONEMENTAL NOISE CONTOURS: THE MILAN MALPENSA AIRPORT EXPERIENCE

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ABSTRACT

This study shows the procedure developed by ARPA Lombardia with the support of SEA (Milan Airport operator) to analyze the impact on noise of a time modification in the ATC operation scheme. In Milan Malpensa two operational scenarios are active to reduce airport noise exposure; one daytime scenario based on aircraft operation performed on both runways and a night-time scenario based on a single runway. Airport setting changes at 11:30 p.m. With the sudden rise in traffic volume coming from the end of the pandemic, a new balance between noise exposure and the modified nature of air traffic sectors flying in MXP had to be undertaken. On June 2022 started a six months experimental period to evaluate the effects of postponing the starting of night-time scenario at 00:30 a.m. The analysis has been made using FAA AEDT 3.e software with the definition of two impact cases based on the two most traffic weeks. A comparison with 2021 LVA contours scenario has been made to characterize the influence of this modification regardless of fleet mix and traffic volumes. Annoyance has been also evaluated. Results show the reduction of population exposed to both 60-65 dB LVA and 65-75 dB LVA contours, especially during the night-time period.

Keywords: noise, environment, airport capacity

1. INTRODUCTION

Milan Malpensa (MXP) is the second major Italian airport[1]. Placed in the north-western part of Italy, inside the Regional Park of Ticino River, is surrounded by a mix of rural and urban environment. In this area, ten small Municipalities for a total population of 100.000 citizens are present. These conditions brought the airport to be strictly connected with the environment of neighbouring territory. MXP airport have to consider all the necessary activities to manage and control the negative externalities from aircraft operations. The environmental impact caused by aviation affects various aspects. In this article we deal with acoustic pollution, which has been historically the main issue. We studied the influence on noise contour and population exposure of a modification in the operational scheme. The analysis has been made using FAA AEDT 3.e software with the definition of two impact cases based on the two most traffic weeks.

2. MILAN MALPENSA NEW OPERATIONAL SCENARIO

In Milan Malpensa two operational scenarios are active to reduce airport noise exposure; one daytime scenario, based on aircraft operation performed on both runways, and a night-time scenario where only a single runway is active. Airport setting changes at 11:30 p.m.

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[1] 186.626 aircraft movements in 2022 (Statistiche Dicembre 2022 - Assaeroporti)

Daytime scenario consists in the daily alternative use of both runways 35R/17L and 35L/17R. Runways switch at 2 p.m. In this scheme, one way traffic flow is established, and airport capacity is 70 mov/h.
Nightime scenario instead is a one runway[2]scheme, with opposite direction for departure and arrival.
This strongly affects airport capacity that is 18 mov/h and the Air Traffic Control (ATC) manage the consequent issue of delay or traffic peak during the scenario change moments.

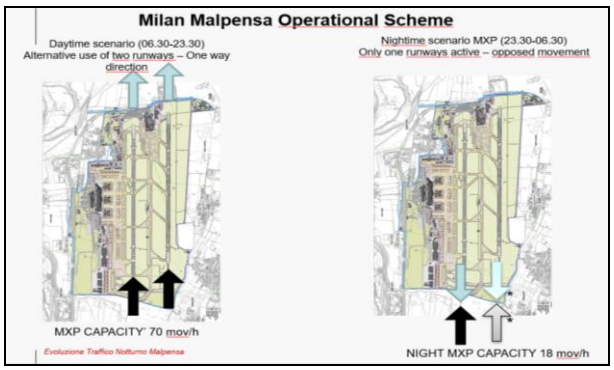

Figure 1. Milan Malpensa operational scheme.

With the sudden rise in traffic volume since the end of the pandemic, a new balance between noise exposure and the modified type of air traffic sectors flying in MXP (more LCC and Cargo, less Legacy and National Carrier) had to be undertaken. LCC and Cargo have their peak of movement during some specific time slot[3].
This breeds capacity issues especially in the beginning of the nightime scenario. Structural delays were observed starting from 2021 summer season. ATC notwithstanding to the nightime scheme could consent departure from runways 35 R/L to decongest but, as far as the growth of both sectors has been consolidated, this exception has taken the risk to be the new normal. Airport Noise Commission[4] on May 2022 decided a six month experimental period starting on 1th June where:

- Nightime operational scenario starts at 00.30 a.m
- No ATC waiver from 00.30 until 06.00

3. ENVIRONMENTAL NOISE ASSESSEMENT

3.1 Methodology

ARPA, in collaboration with SEA, defined a methodology to evaluate noise impact of the new operational scheme.
The objective was the impact evaluation on airport noise in terms of population exposed to LVAj which is the acoustic metric defined by Italian regulation. It is a noise descriptor similar to EU Lden with a 10dB penalty if an event occurs in nightitme. LVAj is composed by LVAd and LVAn.

$$LVA_d = 10 * Log\left[\frac{1}{td}\sum_{i}^{Nd} 10^{\frac{SELi}{10}}\right] \quad (1)$$

$$LVA_n = 10 * Log\left[\frac{1}{tn}\sum_{k}^{Nn} 10^{\frac{SELk}{10}}\right] + 10 \quad (2)$$

$$LVA_j = 10 * Log\left[\frac{17}{24} 10^{\frac{LVAd}{10}} + \frac{7}{24} 10^{\frac{LVAn}{10}}\right] \quad (3)$$

Noise exposure is evaluated by ARPA in a 21 days peak annual scenario simulation:

$$LVA = 10 * Log\left[\frac{1}{21}\sum_{j}^{21} 10^{\frac{LVAj}{10}}\right] \quad (4)$$

Adopting LVA to evaluate the influence on airport noise of this temporal modification of MXP operational scenario, is not an immediate procedure. Here follows some key points considered for the methodology definition.

- Traffic volume.
- Fleet mix and tracks assignment.
- Operational conditions.
- Meteorological data.
- Take Off Weight (TOW).

While traffic volume could be easily normalized to compare different periods, both fleet mix and tracks assignment are too specific for each period to exclude their influence.

[2] Runway 35L/17R is used, Runway 35R/17L only during maintance activities
[3]At MXP, the busiest slots are “the LCC first wave” starting at 6 p.m. and the cargo departure from 22 p.m to 01 a.m, which is in the same slot of the LCC arrivals at night.
[4] Airport Noise Commission is a specific technical/political body defined by Italian noise regulation to manage airport noise. It is headed by ENAC (Italian aviation authority) and formed by members of ENAV (ATC provider), SEA (Airport operator) ARPA (Environmental Agency) and the municipalities around MXP.

Operational conditions, like a runway closure, are also a factor that could modify the tracks assignment.
Second step in the methodology was the choice for the baseline scenario with whom to compare the 2022 experimental period. Initially, the reference scenario was LVA calculated for 2018, considering only the peak summer week. The six months period doesn't cover one year so it is not possible to compare them directly. Focusing on the summer peak, this permitted to analyze the noise impact in the worst condition also for the meteorological effect. Higher temperature reduces air density, and this provide higher noise levels for the same aircraft.

3.2 Preliminary assessment

Both peak summer weeks of LVA 2018 and LVA 2022 (experimental) scenarios share the similar number of movements, about 590 aircraft operations in the average day. First results showed the strong influence of fleet mix. The growth of cargo sector[5] modified the frequency of heavy aircraft like A306, A359, B752 and B788-9.

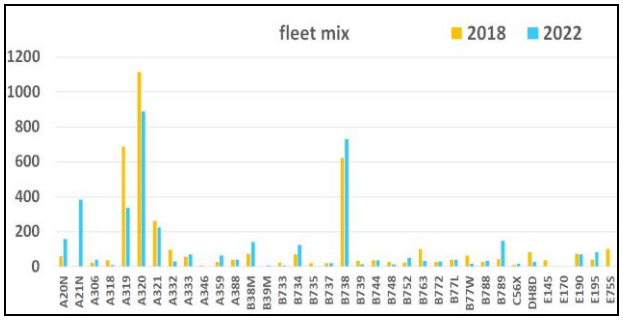

Figure 2. Summer week 2018 vs 2022 fleet mix.

This showed that LVA 2018 was not the correct baseline scenario and so we opted for LVA 2021, a scenario with a smaller number of movements[6] but a comparable fleet mix.
A traffic normalization permitted the first simulation run. LVA 2022 was reduced by a 0.8 coefficient. Meteorological parameters were also similar.
The first run of simulation showed an interesting data where noise contours for LVA 2022 (normalized) were in line with LVA 2021 in the north area were the change in operational scheme impact more and a decrease in the extension of contours in the south area that is a territory strongly affected by noise during the night.

[5] The increase in volume regarded both All Freighter and Jelly freighter category.
[6] 80% of the 2022 LVA scenario.

3.3 Definitive assessment

On January 2023, at the end of the experimental period, it was possible to integrate the peak winter week into the analysis. LVA 2022 winter week has less movements compared to LVA 2021 winter week. The two summer and winter periods were then merged to obtain one fourteen day scenario describing the major annual noise impact with different weather conditions and representing real flight operated by Malpensa airport for both LVA 2022 and LVA 2021. No normalization needed due to the same number of movements of the two definitive analysis scenarios.

4. RESULTS -ANALYSIS

The two scenarios were analyzed both in terms of noise contours and number of people exposed to noise levels. According to Italian regulation, noise contours were calculated for 60, 65 and 75 dB level.

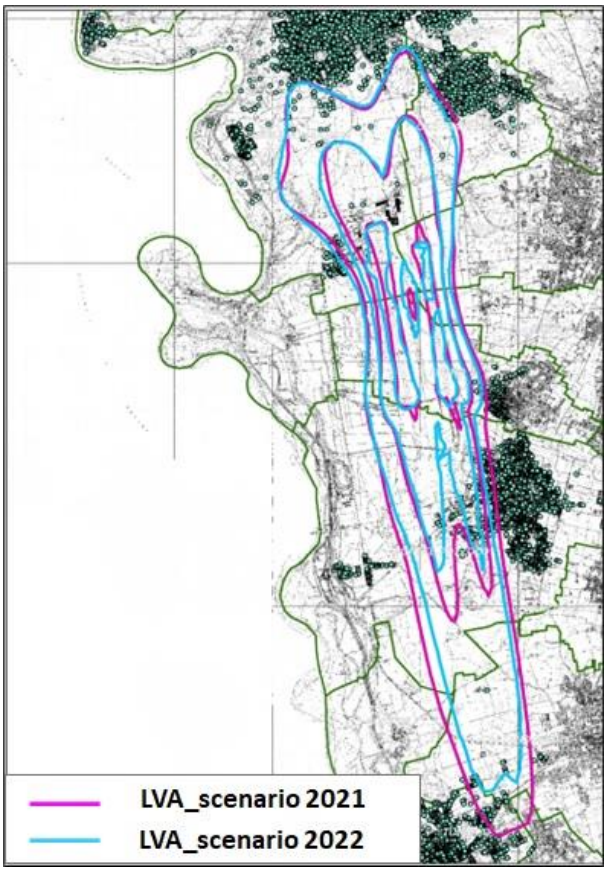

Figure 3. Noise contours for the 2022 (blue) and 2021 (violet) scenario.

Noise contour analysis confirmed the preliminary assessment where the new operational scheme has a limited impact on the north area surroundings MXP with an average increase of five to six daily departure from runways 35/17 largely offset by a significant decrease in the extension of 60 dB LVA contour in the southern area.
Exposed population divided for each municipality around MXP airport for both scenarios is showed in Table 1.
The population analysis shows a decrease in number of citizen exposed, totally located in the southern part of Malpensa. In the north parts we see a small increase completely absorbed by the mitigation in the south.

Table 3. Population exposed – difference between scenarios.

N° citizen exposed	2021			2022			Difference 2022-2021		
	LVA dB(A)			LVA dB(A)			LVA dB(A)		
Municipality	60-65	65-75	Total	60-65	65-75	Total	60-65	65-75	Total
Somma Lombardo	170	30	200	260	30	290	90	0	90
Arsago Seprio	20	0	20	40	0	40	20	0	20
Casorate Sempione	210	0	210	200	0	200	-10	0	-10
Ferno	10	0	10	10	0	10	0	0	0
Lonate Pozzolo	430	70	500	300	60	360	-130	-10	-140
Castano Primo	120	0	120	120	0	120	0	0	0
Nosate	0	0	0	0	0	0	0	0	0
Turbigo	1430	0	1430	520	0	520	-910	0	-910
Robecchetto con Induno	10	0	10	10	0	10	0	0	0

Noise montoring system managed by SEA provides data regarding environemental noise. This data could also provide an indirect information regarding annoyance. Noise levels are influenced by traffic volume differences, but results shows that the elimination of ATC waiver decrased noise levels (LAeq metric) after 1 p.m in the nothern part that sufferend the increase in aircraft operation during 23.30 – 00.30 time change. One of MXP noise monitoring stations is placed inside a cemetry in the city of Arsago, it is a good place to avoid interferences from other souces and to describe the effect of time modification scenario in the acoustic climate of that area. Figure 4 shows that noise measured at Arsago Cimitero station in 2022 is lower than 2021 apart for the small increase in the period 23-00 influenced by new operational scenario.

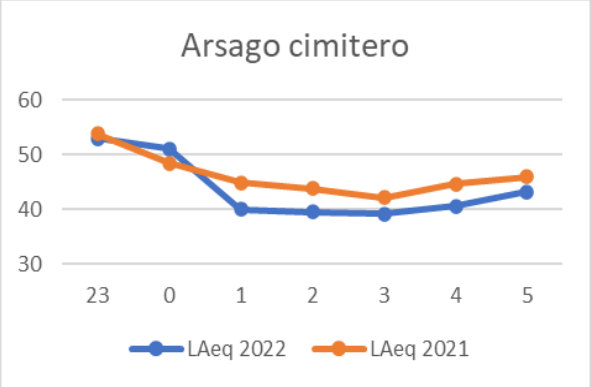

Figure 4. Noise levels measured in MXP expressed in LAeq dB describing environmental noise.

5. CONCLUSIONS

We can affirm that this procedure provided a coherent description of the effect on aircraft noise generated by a temporal modification in the operational scheme active on Milan Malpensa airport. Methodology allowed to identify the suited reference scenario to compare to the experimental period. Simulations were based on the real aircraft movements and assess the sustainability of increases the use of daytime scenario until 00.30 a.m. MXP Noise Commission adopted this results and changed the runway switch at 00.00. The other 30 minutes will be implemented after the establishment of other mitigation options like phasing out less efficient aircraft (from an environmental point of view) and the definition of new SID to decrease the impact on population living in the north that suffered the increase in flights. It could be also a good example of collaboration between airport operator and local authorities to find a shared solution that keeps both airport activities and environmental sustainability.

6. REFERENCES

[1] ICAO, International Standards and Recommended Practices, Environmental Protection, Annex 16 to the Convention on International Civil Aviation, Volume I Aircraft Noise, Eighth Edition - July 2017.

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[3] FAA, Aviation Environmental Design Tool Technical manual, version 3d – March 2021.