ENVIRONMENTAL CAPACITY OF AN AIRPORT AS AN ELEMENT OF BALANCED APPROACH TO AIRCRAFT NOISE CONTROL

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Abstract: The paper presents analysis of Environmental Capacity of an Airport as an Element of Balanced Approach to Aircraft Noise Control. The main aim of the article is to use the concept of airport environmental capacity as according to ICAO Balanced Approach to aircraft noise control and emissions control. The interrelations of environmental, economic and operational capacities are discussed.

Keywords: Airport capacity, airport environmental performances, noise and emissions control.

1 INTRODUCTION

Aircraft noise disturbance is probably the most important factor (first of all, because it is the most geographically extensive form of impact) affecting the operation and development of airports around the world. Most of the world major airports have operational constraints or capacity limits based upon noise. But the future potential growths of air traffic imply that emission sources in the future will increase in importance.

The study of integrated airport impact shows that it is necessary to introduce the concept of airport traffic (operational) capacity according to environmental safety conditions. Evaluation of an airport impact on surrounding environment in terms of noise and air pollution could be realized by defining environmental capacity of an airport. Environmental capacity [1, 2, 3] means such environmental performances of airport (both - operations and future development) that ensure fulfillments of normative conditions of noise at the control points around airport.

The main objective of this research is to use a concept of environmental capacity as it applies particularly to airports according to ICAO Balanced Approach to aircraft noise control and emissions control.

2 THE CONCEPT OF ENVIRONMENTAL CAPACITY

The concept of environmental capacity: as applied to an airport, the notion of “environmental capacity” \( C_{en} \) means reduction of an airport's (and by definition the air transport system's) capacity so as to ensure that airport operational performances comply with the environmental rules [4]. According to this, airport’s capacity \( C \) will be:

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C = \min(C_{op}, C_{ec}, C_{en})
\]

where, \( C_{op} \) - the operational capacity of an airport, \( C_{ec} \) - the economic capacity of an airport, \( C_{en} \) - environmental capacity of an airport.

The operational capacity \( C_{op} \) of an airport can be measured as the number of runway-taxiways slots, the terminal capacity or capacity of the apron areas. The operational capacity is limited only by means of flight safety.

The economic capacity \( C_{ec} \) can be measured as the maximum number of passengers or aircraft, which can be accommodated on a particular day with a given amount of infrastructure under given economic conditions. In a short-term, the airport services load during peak and off-peak period determine these conditions. In the long-term, the availability of investments for airport expansion principally determines the economic conditions (Figure 1).

The impact of the airports’ operation upon the local environment is a major issue, which will affect both the capacity and the potential for future growth. This concept of “environmental capacity” as it applies to airports can be approached in at least two ways:

The first is that an airport's operational capacity is less the total sum of the individual environmental mitigation measures already in place at that airport.

The second is or could ever lead to an environmentally optimal solution:

It is necessary to identify and separate short-run concerns which mainly affect quality of life (e.g., aircraft noise) from long-term issues which mainly affect the assimilative capacity of the environment to cope with what we are throwing at it (e.g., pollution and global warming);

It is necessary to evaluate the viability of the environmental mitigation measures that are in the airport territory and in the vicinity. For example, many major airports have long-established night flight restrictions whose aim has been to protect local communities from excessive exposure from aircraft noise. From an environmental capacity perspective, such restrictions may be seen as a short-run, quality of life issue - and...
3 THE METHODOLOGY OF DEFINING AN AIRPORT ENVIRONMENTAL PERFORMANCES

Evaluation of an airport capacity according to noise and emissions is defined by three groups of conditions: technical, political and social.

Technical conditions:
- Monitoring and creation and survey noise and air pollution data bases.
- Integration these data bases with monitoring system for track keeping survey (for each landing-take-off cycle it is necessary to provide the following information - flight track used, time, aircraft type).
- Monitoring and survey for aircraft maintenance on ground (timetable of engine run-up operations for noise and emissions, aircraft anti-icing handling and painting for emissions).
- Modeling noise contours for various variants of operational conditions (intensity of aircraft operations). It is necessary to evaluate present day intensity of aircraft operations, to predict it for short-term and long-term period. But if the accuracy of such prediction is not sufficient, it is proposed to make noise contours assessment for intensity of aircraft operations equal to operational capacity of an airport.
- Defining sanitary-hygienic zone around an airport according to air pollutants emissions for all activities which generates emissions.
- Correlation noise contours and sanitary-hygienic zone to habitable areas around an airport.
- Analysis of probability that this airport has or can have in future constraints for its capacity or expansion according to its environmental performances.
- Analysis of probability that this airport can be influenced by any capacity constraints in associated airports.
- Land-Use Planning and Management: Planning (zoning, easement, etc.), mitigation (building codes, insulation, etc.) financial (tax incentives, charges, etc.); key to protecting noise reduction and abatement benefits; may involve “opportunity costs” for airports/local government.
- Social conditions:
  - Availability of information about ensuring noise and emissions standards for population living in an airport vicinity.
  - Establishing special service for processing with complaints.

Political conditions:
- Establishing operational constraints according to noise and air pollutants emissions for short-term and long-term perspective.
- Ascertainment of conformity between, on the one hand, profits from airport operation and job placement for local community and, on the other hand, expenses for realization of environmental programs.
- Opportunity to make amendments to norms by means of implementation national, European or international recommendations.

Limitations to noise during observation time $T_{\text{observ}}$ are established in the fixed control points (zones) of noise control in the form of noise levels $L_{\text{Goal}}$ which, usually, serve as equivalent or day/night (which are also equivalent in fact, but include noise impact features during day and night time) levels. In Ukraine the equivalent noise level is established by national regulations as such criteria, for daytime $L_{\text{Goal}}=65$ dBA and for nighttimes $L_{\text{Goal}}=55$ dBA. Limitations to air pollution are established in the fixed control points (zones) of air pollutants emissions control in the form of instantaneous and continuous (effective) concentrations. On the basis of aforesaid the algorithm of evaluation of an airport environmental performances by means of environmental capacity are developed (Figure 2).

4 MAXIMIZING THE ENVIRONMENTAL CAPACITY OF AN AIRPORT

There are three variants of airport development according to the problem being discussed [5]:
1. Capacity changes at existing sites, without physical development.
2. Physical development of airport including new sites or extensions to exiting ones.
3. Implication of redistributed air traffic to other airports.

The key to maximising the environmental capacity of an airport is the integration of environmental management into the corporate business planning process.

It is a characteristic of environmental issues that they can require significant short-term investment in order to ensure long term return. Airport operators need to begin to plan now for the long term in order to meet anticipated infrastructure demand and environmental constraints. It is necessary to invest sufficient resources in environmental management and mitigation to ensure future capacity.

And as applied to the air transport industry it means that not only airport operators are responsible...
for taking into account environmental factor, but also their service partners (airlines and other transport services). Of course, airport operator is the central figure who has to solve the problem of

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**Figure 1** Interdependency of airport capacity types

**Figure 2** Algorithm of evaluation of airport environmental performances by means of environmental capacity
aircraft noise in the working area and in the vicinity (on the local level). All organisations involved need to work jointly and where necessary airport operator has to enforce controls to ensure corporate environmental targets are met and that the environmental impact of the airports total operation is kept to a minimum.

Airlines wishing to develop hub operations at a particular airport may actually take a proactive approach to encouraging the development of environmental best practice in order to secure their own future.

In the long term it is to the advantage of all involved in the air transport industry that it continually strives to improve its environmental performance. Only through such action, coupled with planning for the long term that it will maximise its capacity within a climate of increasing environmental pressures.

An important issue for airports is that the noise contamination can be minimised by:
- minimising noise disturbance using all technological, operational, and planning devices within its power;
- considering mitigation and compensation for affected communities;
- working within standards limits.

5 CONCLUSIONS

A general definition is “Airport Environmental Performances are the individual for each airport characteristics which allow evaluating the interrelation of its operational, economic and environmental capacity”.

On the basis of this analysis it is possible to make the following conclusions:
1. Evaluation the environmental capacity starting from individual characteristics of the airport;
2. On the local level (environmental capacity defining from the environmental requirements on the airport territory and in the vicinity) the ability to assimilate this negative pressure varies widely and is dependent on different factors;
3. The airport is considered as the focus of environmental capacity definition; this can be explained so that there are many negative factors concentrated directly in the airport boundaries. Thereafter the levels of the influence of this factors and hence the number of people being subjected to it are individual for an airport;
4. Effective environmental management and long term planning are the key to ensuring that the environmental capacity and hence the operating capacity of an airport can be maximised.

References


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