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Evaluating enviromental impacts of airport operations

Ocena wpływu działań lotniska na środowisko

Streszczenie: Artykuł skupia się na ocenie negatywnych oddziaływań operacji lotniczych na środowisko. Omawia podstawowe prawa i zasady regulujące relacje pomiędzy lotniskiem i środowiskiem, podobnie jaki opis kategorii oddziaływania: hałasu, emisji spalin, zużycia energii, wody i gleby oraz gospodarki odpadami. W głównej części badania znajdują się kryteria oceny dla tych wszystkich kategorii i pełne studium przypadku z pełną oceną.

Słowa kluczowe: Środowisko, lotnisko, hałas ruchu powietrznego, zużycie energii, spaliny, zanieczyszczenie wody i gleby, zarządzania odpadami z lotniska

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Abstract. This article is focused on evaluation of negative environmental impacts of airport operations. There are basic laws and rules governing the relationship between airport and environment in another part of the article and description of categories of impact: noise, emissions, energy consumption, water and soil pollution and waste management. In the main part of the research are criteria of evaluation for these all various categories and a full case study with complete evaluation.

Key words: environment, airport, air traffic noise, energy consumption, emissions, water and soil pollution, waste management of airport

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INTRODUCTION

Air traffic is reputed to be noisy and dirty. Due to being shown like that in the media, public is often unwilling to approve any improvements that can increase traffic performance. On the other hand, competitiveness of the city and its companies goes down without good availability of air transport. The same goes for tourism. It is good to let public know, that not only airlines and aircraft manufacturers are combating negative effect of air traffic, but also their neighbor, the airport is working on that.

Main goal of this thesis was to create a complete evaluation strategy that will show the relationship of airport and environment to the general public. On the other hand, it has to have a good level of expertise, so that a professional can take a look at it and find out what are the problematic aspects and what can be done to mitigate negative impacts of the airport.

A few laws describing the relationship of airport and environment will be described (of existing infrastructure and from the perspective of planning). The evaluation is based on these rules to be fully compatible, so it can theoretically be used within legal actions, approving of new investments to airport infrastructure and airport reconstructions.

Basic evaluation categories are created: Noise, emissions, energy consumption, water and soil pollution and waste management. Each of these will have its own evaluation conditions. The result will be calculated by weighted average of mark received from each category.

A case study of Poprad – Tatry airport will be created at the end (simulation of traffic at the year 2020). The evaluation will be applied in full extent and a resulting mark will be calculated.

RULES

Many rules and laws govern the relationship between airport and environment. From European Union regulations to national laws and to resolutions of international organizations like ICAO, ECAC or ACI. These rules create a legislative foundation for this evaluation and their requirements will be obeyed completely.

A. Law nr. 100/2001 Sb. about Environmental Impact Assessment

The law is based on European Union directives that require assessing environmental impact of defined projects. Airport projects are assessed if the airport has a runway longer than 2100 meters.(Law nr. 100/2001 Sb.) The law allows a dialogue between the public and the project investor. The investor has to take public complaints into account. Getting building permission is possible only after changing the project to comply with these comments. This secures the mitigation of negative environmental impacts. This evaluation basically prepares assessment documentation and the general public can find out environmental results of the airport all the time, not only during short period of time.

B. Regulation nr. 272/2011 Sb. about Health Protection from Negative Effects of Noise and Vibration

Based on EU regulations, this law defines noise levels acceptable for protected areas around airports. The levels are different for day time (LAeq,16h = 60dB) and night time (LAeq,8h = 50dB). Additionally, airports with more than 50 000 aircraft movement per year have to create a report of noise situation of the airport every two years. (Regulation Nr. 272/2011)

C. ECAC Doc 29, 3rd Edition Volume 1+2 – Report on standard method of computing noise contours around civil airports

The document defines correct ways to calculate noise contours of any airport. An equation:

$$L_{eq,W} = 10 * \lg \left[\frac{t_0}{T_0} * \sum_{i=1}^N g_i * 10^{L_{E,i}/10} \right] + c \quad (1)$$

will be used to calculate noise ballast of airports in evaluation (Koblen,I. - Szabo, S. - Krnáčová, 2013).

ENVIRONMENTAL IMPACTS OF AIRPORTS

The evaluation defines different impact categories that will be rated: Noise, emissions, energy consumption, water and soil pollution and waste management. Each category is described and evaluation criteria are created. There is a demand to rate not only the existing condition, but also the steps that an airport took to mitigate its negative environmental impact.

A. Noise

Chapter describes noise impact on inhabitants of areas near airport. This part is stated in the ECAC Doc. 29 document.

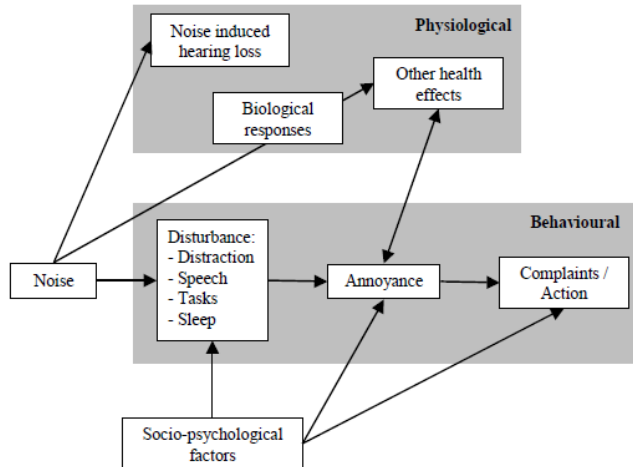


Figure 1. Noise effects

(Source: Koblen, I. - Szabo, S. - Krnáčová, 2013)

Basic noise information is given: what is noise, where does it come from (engine noise and aerodynamic noise). A baseline for evaluation is created and evaluation criteria are defined.

B. Emissions

Same as before, basic information on emissions is given to the reader with specifications to air transport.

Main emissions source are auxiliary power units that are used to produce energy for aircraft on ground. Power source will be taken into account, there are few possibilities like ground power unit or airport power source.

Participation in emission lowering programs is necessary. Each program and investment into new technology is rewarded with some evaluation points. A few projects are mentioned, for example collaborative decision making and WheelTug technology.

Emission rating is also based on LTO cycle – Landing and Take-off cycle. Exact numbers of aircraft emission can be taken from EASA database that can be found on <https://www.easa.europa.eu/document-library/icao-aircraft-engine-emissionsdatabank>.

Table 1. LTO Cycle

Phase	Engine thrust (%)	Duration (min.)
Take-off	0,44	0,43
Climb	0,47	0,46
Descend	0,47	0,51
Idle (taxiing)	0,40	0,43

Source: ECAC, 2005

C. Energy Consumption

Energy consumption is rated according to building energy efficiency as well as electrical appliance efficiency. New investments are taken into account. A huge part of evaluation points is given if the airport creates energy from renewable sources.

D. Water and Soil Pollution

Important part is technical liquid spills prevention and mitigation in case a spill happens. As technical liquids, fuel, oils, hydraulic liquid and de-icing liquid are taken into account. For example, usage variable ratio of de-icing liquid is evaluated.

E. Waste Management

Waste management rating will rate percentage of waste separation and absolute amount of waste generated. Also, new ways to decrease the amount produced will be rewarded.

EVALUATION

The target is to create rating that will have output simple enough for general public. Professionalism and professional relevance is required. Final rating will be given as a single mark calculated through weighted average from partial marks given for each category of environmental impact: Noise, emissions, energy consumption, water and soil pollution and waste

management each will have its own rating. These categories have to be quantified so that a reasonable output will be possible. Each will have a quantity to create a ratio and therefore it will be able to compare different airports and create evaluation criteria for this aspect.

Each category will be rated on its own with maximum of 100 points. These points will be given according to aircraft performance in said category. Final mark will be calculated from partial ones using weighted average as seen in (2):

$$(A*10 + B*5 + C*3 + D*2 + E*5) / 25 \quad (2)$$

A. Noise

First part of noise evaluation is based on number of noise protection area inhabitants. Equations for day and night time are created according to Regulation nr. 272/2011 Sb. limits and noise contours based on ECAC Doc. 29 document. To make this evaluation more complex, another equation is created for a different methodic of noise impact calculation. This methodic does not divide the 24 hour period into day and night time, but has a 55dB limit for 24 hours.

Evaluation takes into account traffic restrictions and step the airport take to mitigate negative noise impact such as satellite navigation usage and night time restrictions.

B. Emissions

The rating in emissions category is based on taxiway infrastructure, stand quality and on setting different landing fees for aircraft according to their emission category (emission category of their engine).

Ground vehicle types are taken into account as well as the transport type that connects the airport to its city.

Emission reducing programs and technologies are also point relevant, programs like Airport Carbon Accreditation or Airports Going Green were mentioned, as well as new technologies like WheelTug or CDM (Collaborative Decision Making).

C. Energy consumption

Energy consumption is divided into three subcategories: electricity consumption, building energy efficiency and renewable sources of energy.

Electricity consumption is calculated using one of two methods: either by using new investments or by calculating efficiency of appliances. In case of investments, improvements in efficiency are calculated. In case of appliance efficiency, efficiency labels are used to calculate efficiency of all appliances on the airport.

Building energy efficiency is calculated based on law 406/2000 Sb. Final rating is calculated as weighted average of building efficiency and its area

As for renewable sources of energy, it is important that the airport at least starts to build infrastructure to use them. Points are added according to what part of energy used the airport creates from these sources (using wind turbines, solar panels and photovoltaic cells and others).

A. Water and soil pollution

Two main sub categories here, one is how the airport is prepared to handle liquid spills and what is done to prevent them, the rest is calculated on absolute number of liquid spills in the last 5 years.

B. Waste management

Rating is based on percentage of separated waste as well as absolute amount of garbage produced at the airport site. To earn the full point gain, it is necessary to start at least one other program to reduce waste produced, e.g. composting.

CASE STUDY WITH FULL EVALUATION OF AIRPORT

A case study of the Airport Poprad – Tatry in the year 2020 (as simulation) will be carried out. Each of the aforementioned categories is given its evaluation and a final result is calculated in the end of the paper.

Table 2. Simulated Traffic on Poprad – Tatry Airport

Year	2016	2017	2018	2019	2020
PAX	91 452	113 256	129 158	135 368	172 458
Movs.	7	6	7	7	7

	211	985	325	564	785
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Source: Authors

Noise contours were calculated based on ECAC Doc 29 along with an estimate of number of inhabitants inside these contours. Noise abatement procedures were described and for the category of noise, the airport was awarded with 67 points.

Category emissions was rewarded with only 22 points. There is need to use APUs for standing aircraft and the airport lacks necessary taxiway infrastructure. Aircraft have to taxi on the runway. In addition, the airport does not participate in any emission lowering program and there is only a bus line connecting the airport to the city centre.

Energy consumption was rewarded with 67 points. The airport invested in renewing appliances and its building efficiency is sufficient. On the other hand, it does not use renewable energy sources.

Water and soil pollution was rewarded with 50 points. There was no liquid spill in the last 5 years, but there is a minor shortness in prevention (not enough training and prevention). The airport does not have a variable ration de-icing vehicle which leads to extensive use of de-icing liquid and this liquid is then spout into environment.

Waste management was rewarded with only 38 points. This was caused mainly by low amount of garbage separated (only 45%). However, the airport produces fairly low amount of garbage on passenger and it does have a composting place.

Final result is 54,44 points, which means final mark D. Based on the size of the airport, this is an acceptable result that gives opportunities to improve performance in categories that were rewarded with low point gain.

CONCLUSION

The aim of this research was to establish criteria for evaluation of airports environmental impact. Criteria were set in compliance with current situation. In this case, it is very difficult to change things such as the location of airport near habitated areas. Another issue is to change airports precautions which leads to decrease of negative impact to environment. On the other side,

criteria standards are well set to motivate airports to work on its influences on environment in a complex manners in order to decrease negative externalities in all evaluated categories over long period of time.

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