

# **CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE**

Faculty of Economics and Management  
Department of Economics



Diploma Thesis

## **Hedonic pricing of real estates affected by Václav Havel Airport Prague**

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## **Declaration of Integrity**

I hereby declare that I have elaborated the Diploma Thesis on the topic of “Hedonic pricing of real estates affected by the Václav Havel Airport Prague” on my own, only with the help of expert consultations and with the use of credible sources of information, which I am stating in the text and also mentioning in the references.

I entirely agree that my Diploma Thesis can be saved in the library of the Czech University of Life Sciences Prague and can be available for other study purposes.

In Prague 30.3.2015

Štěpán Šášinka

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In Prague 30.3.2015

Štěpán Šášinka

**HEDONIC PRICING OF REAL ESTATES AFFECTED  
BY VÁCLAV HAVEL AIRPORT PRAGUE**

**HEDONICKÉ OCEŇOVÁNÍ NEMOVITOSTÍ  
OVLIVNĚNÝCH MEZINÁRODNÍM LETIŠTĚM  
VÁCLAVA HAVLA V PRAZE**

## **SUMMARY**

The Diploma Thesis deals with the impact of noise influencing the price of real estates in vicinity of the main and the largest airport in the Czech Republic – Václav Havel Airport Prague. For this purpose the hedonic pricing method (HPM) was selected as the main research tool. The first part, so called the literature overview is based on the theoretical information about the method and its using. Also airport introduction and description as well as the problems connected with higher level of noise caused by the air traffic are described there. The main part is about the research by using HPM. This part is called the own contribution. At the end of the thesis the supplementary part is situated where all the supplements are attached.

**Key words: hedonic pricing method, airport, traffic, air pollution, noise, properties, real estate market**

## **SOUHRN**

Diplomová práce se zabývá dopadem hluku způsobeným největším a nejvýznamnějším letištěm v České republice – Mezinárodním Letištěm Václava Havla v Praze – na cenu nemovitostí, nacházejících se v jeho blízkosti. Pro tento účel byla jako nejvhodnější zvolena metoda hédonického oceňování (HPM), která je popsána v první části práce. Teoretická část se zabývá popisem této metody a její aplikací v praxi. Dále pak zahrnuje informace o Mezinárodním Letišti Václava Havla v Praze. V neposlední části se autor věnuje problematice hluku. Druhou část práce tvoří autorův vlastní přínos nebo-li praktická část. Podrobně byl proveden výzkum a analýza leteckého hluku a jeho dopad na cenu nemovitostí. Byla aplikována metoda hédonického oceňování. Poslední část diplomové práce tvoří přílohy.

**Klíčová slova: metoda hédonického oceňování, letiště, provoz, znečištění ovzduší, hluk, nemovitosti, trh s nemovitostmi**

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## 1. INTRODUCTION

There are many factors affecting the quality of living and the real estate market at all. All these things have a specific and very often a significant impact on the final price of a real estate but what is more important, people usually make their final decisions according to these pros and cons. Therefore it is very important to know the real value of any real estate anybody is interested in and also know the reasons – factors influencing this value in either positive or negative sense. The Václav Havel Airport Prague was chosen because of its scale and importance for the air transport in the Czech Republic. It is the largest airport with the heaviest air traffic in the country. Prague as the capital city is also the area with the highest demand for real estates and it is possible to find various and often very different prices of these houses, flats etc. There are very different opinions on a quality of living in the vicinity of the Václav Havel Airport Prague. While for some citizens of the Czech Republic it could be very positive to live at this place, for each other it is more about suffering or surviving. The reason why the author decided to focus on this topic is because there are many different factors affecting this opinion on quality of living that should be taken into account. It is also not absolutely and clearly proven if there really is the significant impact of the airport, either negative or positive. The author of the thesis therefore focuses on the possible impact of the Václav Havel Airport Prague on the surrounded real estate market. Recognizing and setting the level of impact is also expected from the author's research. For the purpose of the research and results evaluation the hedonic pricing method (HPM) was selected as the most suitable.



## **2. AIMS AND METHODOLOGY**

The main aim of the Diploma Thesis is to investigate the relation between the selling price of properties located in the vicinity of the Václav Havel Airport Prague and the significant level of noise caused by this airport. For these purposes the hypothesis was set by the author in the beginning of the thesis writing. According to this hypothesis the selling price of flats and houses located in the vicinity of the Václav Havel Airport Prague is negatively influenced by the higher level of noise in these locations. The research consists of data gathering and transforming to MS Excel and afterwards the internal and environmental characteristics of every examined property are tested.

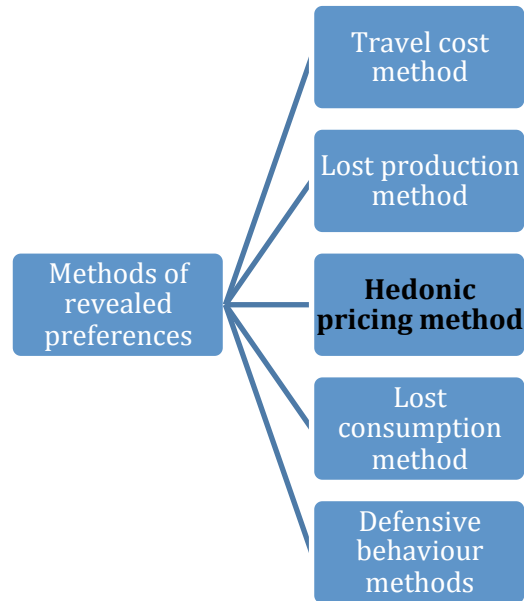
Diploma Thesis consists of the following parts. There is a literature overview in the beginning also called the theoretical part. All the definitions are considered in the first part, it introduces a history of the Václav Havel Airport Prague and the surrounding locations that are involved in the research. Description of the Czech Republic real estate market as well as the hedonic pricing method is described there. The second part could be also called the main practical part because it deals with the author's research and finally showing the results of the research. Noise was set as the most important and significant disturbing environmental attribute influencing the residents living nearby the airport. Therefore the main part of the thesis is focused on the negative influence of selling price by a high level of airport noise in surrounding areas. At the end of the thesis, the last part, where are all the supplements, is listed. After the reading of all mentioned parts, readers should completely understand the topic and find the results of the author's research based on the hedonic pricing method.

### **3. THEORETICAL PART**

#### **3.1. Hedonic pricing method and its application**

Prices of goods or services are a result of supply and demand in the relevant market. In other words consumer compares the costs necessary to obtain an asset with the resulting benefits. The price of goods or services can be set through the market mechanisms, however, only for those commodities for which there are competing markets. For the price determination of goods and services where their markets are imperfect, it is necessary to use some specific methods. Most of the environmental assets and services belong to this category. Determining of the value of non-market environmental assets is primarily based on the consumer theory, which examines how the consumer decides on the allocation of his or her limited income between different assets. In case of the environment, from the consumer's perspective it is about the choice between the spending on the environmental quality and expenditures on the other assets. Neoclassical economic theory defines the economic value as a result of an individual's willingness to pay for a good or service (WTP) or for the exclusion of certain unwanted costs. Another possible approach to determine consumer preferences is alternatively willingness to accept compensation for the environmental degradation (WTA). The Consumer expresses by his/her WTP or WTA, the preference of the estate, respectively how much he or she appreciates the environmental assets. It is possible to construct the demand curve, on the basis of valuation of such asset by the consumer. The question is which method is the most suitable for the purpose of finding the most realistic and appropriate value of particular environmental assets. There are a lot of methods suitable for the evaluation of the environmental assets at the present time. Basically these methods can be divided into two main categories. In the first category the total present value of certain services of a specific environmental resource is examined. This value is represented by the amount of natural capital of useful or useless services or the evaluation of damage

from pollution and the decrease in the present value is measured. The damage can be judged by the amount of costs necessary for restoring the original source or also indirectly through the level of damage on the people's health and wealth. There are so called preferential methods and non-preferential methods. In case of preferential methods the WTP and WTA of people for maintaining or improving the environmental quality is being examined. This approach uses the principle of measuring the benefits of a particular asset, expressed by consumer's demand curve. The hedonic pricing method belongs to this category, therefore next part of this chapter focuses only on so called preferential methods. This category also has two subcategories. HPM belongs to the group called Methods of revealed preferences. This group focuses on the consumer behaviour on the real estate markets associated with analysed product. Such methods are widely used in practice because of the good theoretical basis of the model and also due to high empirical efficiency. It means that the result can be very accurate while using the quality sources. If the results are not accurate their deviations can be set very well. If talking about the environmental evaluation, four main methods are usually applied. Hedonic pricing method, travel cost method, defensive behaviour and the lost production or lost consumption method. The only limit of methods of revealed preferences is the fact that only the evaluation of utility value can be measured. For the purpose of this thesis, to analyse the influence of an abnormal level of noise caused by the Václav Havel Airport Prague the HPM was selected as the best one. The approach based on the hedonic regression model is one of the most appropriate while taking into account the influence of various factors on the price of real estate. It is also interesting that HPM is widely used all over the world, however in the Czech Republic, usage of this method is not so common. [8], [9]



**Figure 1: Scheme of the methods of revealed preferences**

*Source: [6], [9], made by author*

The word “hedonic” comes from Greek language and means pleasure. Hence the hedonic pricing method (HPM) relies on information provided by households making decision about living. People derive pleasure by living in nice, calm and well-equipped locations. Basically it is possible to note that the higher housing price means better living conditions. Citizens are often willing to pay higher amount of money for the amenities in nice places. Air pollution, water purity, distance to the nature, noise level etc. All of these aspects have an important direct impact on the property values. The method infers the value of environmental features from the price of traded goods. It is being used and applicable in those cases where the price of any asset is directly affected by surrounding environmental factors. A housing market is the most frequently used example. In this case the value of two otherwise comparable properties or for example apartments will differ according to the environmental aspects in the vicinity of such properties. For example, in case of the proximity to a hazardous waste site leads to a measurable drop in the

property price (compared to equivalent building in other locations), such difference gives an indicator of the external cost of the waste site. On the other hand it is also possible to measure the external benefits by using of this method. If the property is situated in the very calm and undisturbed area with very nice nature and well-developed infrastructure and public transport, there is supposed to be a higher price of this property, because of the external benefits. <sup>[13]</sup>

Hedonic pricing model in the common form can be characterized as follows. “P” that means price of property and vector “z”. Vector “z” is a vector of characteristics explaining the price of property. Price of the property (P) is either selling price or renting price. There is a very big difference between these two prices. The renting price is a price that people are willing to pay for a short time period such as one year or a few months. In this case price does not consider expectations about the future development of environmental attributes in vicinity of property. Price is fully derived from the utility value of the property for the rental time period. Selling price reflects also these expectations of potential buyers about the future development of the property’s surrounding. In case there is supposed to be any change in the environment causing the decrease of quality of living in such location, this change reflects to the selling price. It is possible to say that this price considers current living conditions as well as the expected future living conditions of the property and location. Explanatory variables (vector “z”) are characteristics of a property affecting its price. Those characteristics can be divided into three following groups <sup>[13]</sup>.

1. *Structural characteristics of property*
2. *Surrounding of property*
3. *Environmental characteristics*

Structural characteristics are directly connected with the property condition, age, number of rooms, size of the land, garage etc. Second point, surrounding of

property considers distances to important places such as school, shops, supermarkets, availability of public transport, infrastructure and of course criminality and job opportunities (level of unemployment). The last bullet is focused on environment. Quality of air, air and water pollution, level of noise, distance to the nature or availability of park but also distance from the nearest dump can affect the price significantly. The basic function of HPM therefore looks as follows:

$$P(p) = f(s,n,e)$$

Where “Pp” means the property price, “s” is a vector of structural characteristics of property (size, status, number of rooms...), “n” stands for a vector of location (area where the property is located) and “e” is the environmental vector. The basic function of HPM says that with an increasing quality of environmental attributes (better environment) the price of property is also increasing. The two-stage HPM model is based on the Lancaster’s theory of consumer’s goods defining such assets as a group of attributes that determines its characteristics. It was also developed from the Rosen’s model which extends the whole model of the demand side analysis. For the implicit price calculation it is necessary to find the hedonic price function. HPM has been used since the 20s of the 20<sup>th</sup> century. Massive expansion was in 60s of the 20<sup>th</sup> century mostly because of the air quality valuation. <sup>[4]. [1]</sup>

The HPM is not so widespread and often used in the Czech Republic in relation to the real estate market but also the labor market. One of the main reasons is that before the year 1989 when the Velvet revolution took place there was non-existent or distorted real estate and labor market. In the following years the situation has been rapidly changing. Shortly after the 1989 when the democracy started here, the real estate market was quite specific because of the deregulation of rent and privatization of the municipal housing stocks. Due to this reason one of the most important preconditions is not fulfilled. There is no other absolutely competitive market, that would not be regulated. But after all, the HPM is getting more and more applied also in this country. <sup>[4]. [1]</sup>

## **3.2. Václav Havel Airport Prague**

Following part is dedicated to the Václav Havel Airport Prague only. Firstly the brief history is stated here and then the description of the airport, its development and future plans are part of the chapter. Second part is focused on the disturbing elements of airport, potential environmental threats and measurements. The largest part of the chapter is about the noise caused by air traffic operating to and from the airport.

### **3.2.1. Brief history and development**

Czechoslovakia, today's Czech Republic was one of the most famous and important countries in the field of aviation. Since the first aircraft took-off from the field close to Kitty Hawk in the USA in the 1903 many very important events had happened in Czechoslovakia. One of those events was a construction of the largest airport in the country. The Ruzyně airport was opened on 5<sup>th</sup> of April 1937 for the first time but until that time there had been used a Kbely airport as a main airport in Prague since 1919. This airport is still in use but only for military and governmental operations and purposes. The Prague Ruzyně was awarded for many times, the first award came shortly after the opening in 1937. Most of these awards are because of the architectonic reasons. There were six grass strips for a take-off and landing purposes. All of them were in an angle of 45° to each other so it was possible to perform take-off or landing against the wind direction almost every time. During 1940s the first paved runway (RWY) was built in Prague Ruzyně in reaction to the quick development of air transport segment. All these factors led to high interest of airlines after the WW II when the airport was fully under control of German Luftwaffe. During this time the airport was significantly broadened out. After the WW II the airport construction and modification (widening) continued. From the geographical point of view, it is situated very close to the

capital city which is a great advantage in comparison with some other international airports in Europe or in the World. Between 1989 and 2006 the main terminal – Terminal North 1 was completely reconstructed and two new terminals – Terminal North 2 and Terminal South 2 was built and opened. Also a great reconstruction of main runways, taxiways and aprons was done in the 1989 and 1993. In 2013 the radical works took place on the main RWY 24/06. The runway was totally repaired. The airport is officially called the Václav Havel Airport Prague since October 2012, in tribute to the first president of the Czech Republic. <sup>[2], [18]</sup>

The airport is now being operated by Letiště Praha a.s., a subsidiary of Czech Aeroholding group (joint stock company). Prague airport is one of the most frequent airports in the Central Europe and it is also one of the fastest developing. The largest amount of checked in passengers was in 2008, there were 12.63 million people flying through. There are two runways at the present time. The problem is that these two runways are crossing each other it means it is impossible to use both of them at the same time. Therefore one more parallel runway is being planned and should be built in a future because of the capacity maximization. Scheme of the third RWY 24L/06R is attached in the supplementary part. <sup>[18]</sup>

There are three large airports around the city of Prague but only the Václav Havel Airport Prague is being used for the international traffic. The others are for military or training purposes only (Kbely, Vodochody).





**Figure 2: Map of three large airports around the city of Prague**

*Source: Google maps <sup>[15]</sup> by author*

### **3.2.2. Significant disturbing elements**

According to the National Institute of Public Health (NIPH) it is proved that the noise burden of the population in the Czech Republic is created by the 40% by the working areas and by 60% by non-working areas. In the big cities and larger towns the main source of noise is the non-working one produced by the transport, usually heavy road and other traffic. It has been medically proven that a high amount of noise has a negative impact on the human health. Especially when people are under the high burden of noise for a longer time period which is really alarming because of causing dangerous diseases such as heart attack, high blood pressure, chronic fatigue, sleeplessness and depressions. The last researches show that

more than 40% of the European population is working or living under the higher noise level than is set by the limits. More than 100,000,000 of the EU citizens is being hit by the enormous noise reaching more than 65 dB. In Prague there are about 8% of inhabitants affected by an enormous noise. It is more than 90,000 people. There are four main sources of noise in big cities and towns according to NIPH. <sup>[17]</sup>

**I. Traffic noise**

**II. Noise of working areas**

**III. Housing noise**

**IV. Free time and other noise**

For the purpose of the thesis the first source of noise was chosen. Road, railway and air transport belong into this category. It is necessary to focus mainly on the traffic noise caused by air transport because of the airport influence affect. Since the year 2002 most of the very loud and old aircraft have been forbidden, to be operated at the most of the EU airports. This is regarding to the 92/14/EEC directive. Generally a newer airplane means a less noise because of the very strict environmental requirements during the construction of today's aircraft. On the other hand the density of air traffic is still increasing and during the last decade there has been a significant increase of the low cost carriers so the traffic would be probably heavier in the future. From the air traffic and airport noise point of view in the Czech Republic, the most problematic is of course the largest international airport – Václav Havel Airport Prague. <sup>[6], [7]</sup>

As it was already mentioned there are two main problems arising from the airport and its traffic. It is air pollution (emissions) and a noise. All of these problematic factors do not have a direct impact on civilization when the aircraft is cruising in its cruise flight level. The negative factors are perceived when the air traffic is in vicinity of the ground, it means when aircraft perform take off and landing. It is obvious that the biggest problem and burden is close to the airport. This is a well known issue and all subjects and organizations involved are dealing with this topic and still developing new and modern methods which should help to challenge it. By the International Air Transport Association (IATA) only 3.5% of emissions affecting the global warming are created by the air transport, while it generates more than 8% of the world GDP.

The greatest disturbing element caused by the air transport is a noise. It is also the most perceived one. In case of airport noise can be divided into two main categories. <sup>[5], [11]</sup>

**a) Noise created by air traffic**

**b) Noise created by other airport operations**

The first category comprises the noise directly connected with aircraft operating at the airport, performing their take offs and landing there. This is also the most significant and noticeable. In the second category there is a noise created by other airport operations such as ground machinery and other airport equipment but also the public and individual transport to/from the airport. There is a lot of existing instruments for dealing with the noise at and around the airport. These instruments have been mostly established by the International Civil Aviation Organization (ICAO) and most of them are plentifully in use in case of the Václav Havel Airport

Prague. Those instruments are introduced and characterized in the next chapter. Basically there are active and passive tools and procedures how to deal with the noise. Usually the most important is to reduce the noise right at its source. In case of air traffic this source is aircraft operation to/from the airport. For this purpose aircraft noise categories were established by the ICAO according to the level of noise produced. In the Czech Republic as well as in the most of the EU countries only three most strict categories are in use. From this point of view it is obvious that aircraft manufacturers have to fit their aircraft into one of these three categories otherwise there will be a problem during their future operations. On the other hand there are still a lot of old and noisy aircraft in use at the present time and these aircraft also operate to some EU and other airports. In this case airlines or operators of such aircraft must pay special taxes otherwise they are forbidden to use this type of aircraft during some critical hours (evening, night, early morning). As mentioned before there are preventive and follow-up procedures which any airport should have.<sup>[11]</sup>

The first category is about the location of airport that could not be usually changed. Very important is also setting and monitoring of departure and arrival routes (corridors) where the aircraft should fly very precisely and in a correct altitude (as high as possible and out of the built-up areas as long as possible). Also the usage of runways must be coordinated with Air Traffic Control (ATC) while there is more than one runway at the airport. Of course the safety is on the first place and air traffic should use the runway where the landing and take-off will be easier and safer. On the other hand if possible the runway where a noise of the arriving and departing traffic is not so disturbing because of the geographical position and orientation should be preferred. Another instrument how to restrain the noise is a noise protection zones declaration. Such zones must be declared in the vicinity of every airport with schedule traffic and production of significant level of noise. It is described deeper in Annex L16 in case of the Czech Republic. There are for example special rules for construction of sensitive facilities such as

hospitals, schools etc. in these noise protection zones. Another very useful tool is a strict prohibition of aircraft of some noise category like lower than ICAO Noise Category 3. This is the case of the EU. Also some periodical temporal prohibition can be done. A very nice example is a nighttime operational restriction. <sup>[11]</sup>

As a great follow-up procedure the reconstruction of buildings in the vicinity of the airport (new special anti-noise windows and doors), and a financial support to villages, towns and other involved and affected areas can be introduced. A noise tax is established here for such purposes.

To use all of these instruments or tools correctly it is necessary that the airport has monitoring stations and performs the monitoring steadily. Also the public discussions with citizens from villages, towns and locations nearby the airport should be done every year. According to the latest researches the total level of noise caused by air transport is decreasing. It is mainly because of new technologies using, following strict procedures and legislative etc. It is happening while the total amount of the air traffic is still growing. It is interesting to note that on the basis of IATA the level of noise produced by the aircraft constructed after the year 2005 is about 50% lower than the level of noise of aircraft produced in the first half of the nineties. In the beginning of this chapter the public and nonpublic transport was mentioned as another important producer of noise. Every airport in the world therefore tries to provide as available as possible connection between the city and the airport operated by the public transport. The ecological friendly types of public transport are being preferred during the last years because of improving the environmental quality. <sup>[5], [11]</sup>

<b>Outside noise</b>	<b>Day (6:00-22:00)</b>	<b>Night (22:00-6:00)</b>
<b>Basic limit – other types of noise</b>	<b>50 dB</b>	<b>40 dB</b>
<b>Road transport noise</b>	<b>55 dB</b>	<b>45 dB</b>
<b>Railway transport noise</b>	<b>55 dB</b>	<b>50 dB</b>
<b>Noise around the main roads</b>	<b>60 dB</b>	<b>50 dB</b>
<b>Noise inside the NPZ</b>	<b>60 dB</b>	<b>50 dB</b>
<b>Old noise pollution</b>	<b>70 dB</b>	<b>50 dB</b>
<b>Old noise pollution caused by the railway transport</b>	<b>70 dB</b>	<b>65 dB</b>

**Table 1: Basic noise limits for the outside noise (houses, flats, etc.)**

*Source: Environmental Law Service<sup>[20]</sup>*

### **3.2.3. Anti-noise and other measures**

Letiště Praha a.s., as the operator of the Václav Havel Airport Prague is responsible for providing monitoring of following operational impacts.

- **Ground water quality monitoring**
- **Surface water monitoring**

- **Air quality monitoring**
- **Fruit and agricultural products monitoring**
- **Soil and subsoil monitoring**
- **Noise monitoring**

Noise monitoring is the most important for the purpose of the thesis. Therefore the other issues are described briefly at first then the whole subchapter is devoted to the noise monitoring. <sup>[12], [18]</sup>

## **Groundwater quality monitoring and measurements**

It takes place from 2 to 4 times per a year, depending upon the importance of the location. It involves regular wells samples. A specialized hydrogeological firm takes groundwater samples and subjects them to laboratory analysis on behalf of Letiště Praha a.s. Oil concentrations are primarily monitored in the samples. At selected hydrogeological wells, chlorinated hydrocarbon concentrations are also monitored. The results of groundwater quality analysis measurements are always included in the annual reports which Letiště Praha a.s. submits to state administrative bodies. In the immediate proximity of the Central Warehouse for Aviation Fuels, next to the village of Kněževy, some hydrogeological wells were selected to be equipped with a modern automated monitoring system which takes readings of underground water levels and the presence of oils in well water. Installation of the system fully respects the requirements of the Water Act and its implementing regulations as relates to buildings containing substances which may be harmful to water. <sup>[12]</sup>

## **Surface Waters Monitoring**

Operational monitoring of surface waters contributes to the comprehensive evaluation of the impact of the Václav Havel Airport Prague operations on the ecology of the Kopaninský and Únětický streams. Evaluations are done of both the chemical status of the streams, using sampling of water and sediments, and the biological and ecological status of the streams, based upon monitoring the status of communities of organisms and biological buildup. <sup>[12]</sup>

## **Air Quality Monitoring**

Letiště Praha, a.s. regularly measures the quality of the air at the airport and its vicinity. It also takes a measurement of selected source of pollution to evaluate whether the air protection limits set by law are fulfilled and not exceeded. Letiště Praha, a.s. also determines the emissions produced during individual flight phases, so-called LTO cycle. This procedure is based upon the methodology of the ICAO. These results allow an inference to be made concerning which types of aircraft are dominant in terms of the air pollution, what impact the travel times have on the amount of pollutants emitted, and so on. <sup>[12]</sup>

## **Monitoring Fruit and Agricultural Production**

In cooperation with the Institute of Chemical Technology based in Prague, Letiště Praha a.s. monitors fruit and agricultural production. Because of the absence of regulations in the area in Czech law, the samples are evaluated using a methodology taken from the Environmental Protection Agency in the USA. The resulting yearly summary concerning the monitoring is sent to villages and municipalities where the samples were taken. <sup>[12]</sup>



## **Soil and Subsoil Monitoring**

As part of preparing for airport's future investment activities, it takes samples of soils and subsoil at the airport area, as well as in the takeoff and landing corridors. A time series is created from the results. From the long term results it is obvious that the airport does not have any harmful impact and influence on the soil and subsoil quality right at the airport or in the surrounding locations. <sup>[12]</sup>

## **Noise monitoring**

The noise from the approaching and departing air traffic is the most disturbing element, influencing the people living in areas nearby the airport. Letiste Praha a.s. is therefore attempting to minimize the noise caused to the surrounding environment by civil aviation traffic by implementing a number of operational, economic and technical measures. Regarding these techniques and procedures there has been no expansion of the areas affected by noise from the airport traffic since 1998, while the traffic density is still increasing. <sup>[12]</sup>

Following three types of measurements are being used by Letiště Praha a.s. at the present time. <sup>[12], [18]</sup>

### **1. Operational measures**

These measures have been developed in step with aviation operations and respect societal and legal requirement. They are very deeply described in the Aviation Information Handbook of the Czech Republic (AIP CR). Such measures involve special procedures and restriction that must be followed by the air and ground traffic operating at the airport. Restriction on nighttime operations, landing and departure rules, engine testing rules, runway system preferences in coordination with ATC as well as bans on take-offs and landings for some aircraft without corresponding noise certification etc. All of this belongs to the category of operational measures.

## 2. Economic measures

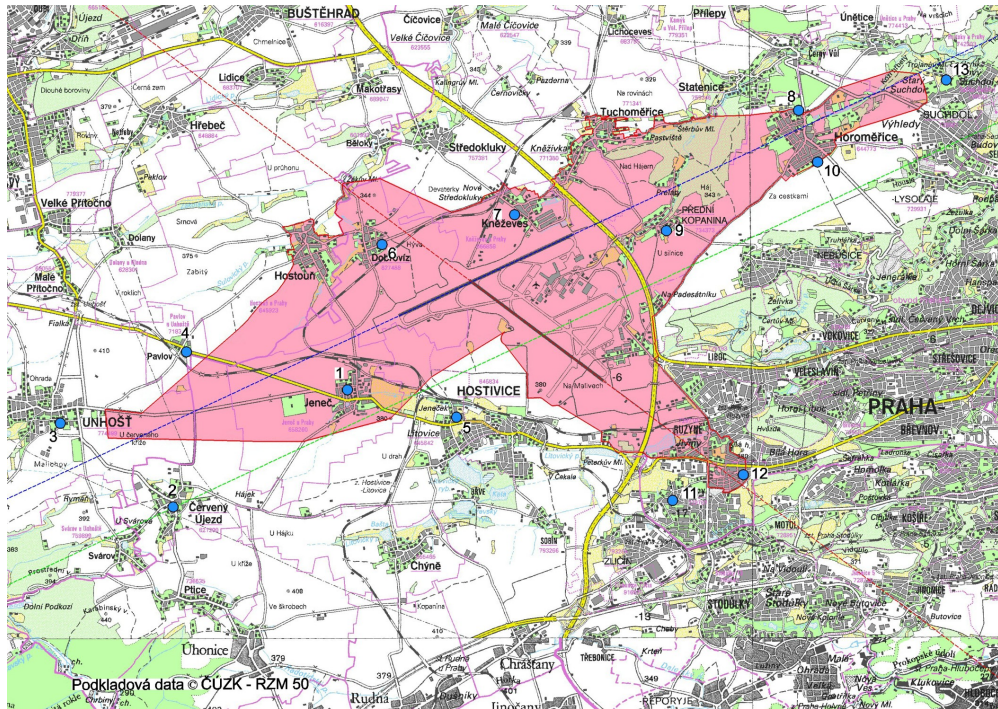
This form of measures is mostly about the fees and taxes establishment. These noise fees are in direct relations to aircraft noise levels. It provides a significant incentive for airlines to use the quietest and modern aircraft at Václav Havel Airport Prague. Currently there are five categories according to the level of noise produced by aircraft. It is also depending on maximum take-off weight of every aircraft (MTOW). All these categories are briefly described in ICAO Annex16/I and could be found in the supplementary part of the thesis. Revenues created by those fees are used to cover the construction and maintenance of monitoring stations and facilities, employees and programs involved to the noise monitoring and measures. They also have been used as a compensation for surrounding areas (villages, towns and districts of Prague) affected by excessive noise since 1998. Generally following three categories of fees are in use at the Václav Havel Airport Prague by Letiště Praha a.s. at the present time. <sup>[12]</sup>

- *Fees for now following the slot coordination*
- *Fees for breaching the nighttime operations rules*
- *Fees for breaching the visual approach rules and procedures*

## 3. Technical measures

This is the most extensive part of this chapter because of the importance of technical measures. At first the **Noise Protection Zones (NPZ)** must be set around the airport. These zones are visible in the figure 3, below this paragraph. It must be complying with the legal requirements. The noise limits are described in the Table 1 in the chapter 3.2.2. of the thesis. Generally the

most important are the following limits. During the daytime the noise caused by the airport and air traffic cannot exceed 60 dB, during the nighttime it is 50 dB. These limits are based on the typical flight day.



**Figure 3: Noise Protection Zone of Václav Havel Airport Prague and locations of the monitoring stations**

Source: Letiště Praha a.s. ([www.prg.aero](http://www.prg.aero)) [18]

Another form of noise reduction is the **aircraft noise mitigation program**. Since 1998 a significant cooperation between the airport and surrounding locations (towns, villages etc.) has begun. Complete exchange of windows and doors has been done there. The main focus is on so-called protected areas into which belongs schools, hospitals, family houses and flats etc. All of these buildings are part of the noise protection zone of the Václav Havel Airport Prague. Very important part of the technical measures is also the **land-use planning**. The

primary objective is to ensure that the number of people living with excessive noise caused by air traffic does not increase. The noise protection zone of the Václav Havel Airport Prague has been incorporated into the zoning plan of the villages, towns and districts of Prague very close to the airport. Letiště Praha a.s., as the operator of the airport makes comments on these zoning plans so the future construction is influenced by discussion between the representative body of surrounding villages, towns etc. and the representative of Letiště Praha a.s.. Another very important part of the technical measures is the **monitoring of the aviation noise and aviation routes**. At the present time the ANOMS 8 system is used for such monitoring at the airport. It has been operated by accredited MaREXCOM laboratory, a part of the Australian company Lockhard since the year 2008. This company has a lot of great experience with monitoring of aviation routes and noise. Currently the system is in use at more than 130 airports all around the world. The monitoring system at the Václav Havel Airport Prague currently includes following <sup>[12]</sup>:

- *13 stationary stations with 13 meteorological stations*
- *2 mobile measuring stations*
- *Letiště Praha a.s. terminals*
- *MaREXCOM and Lockhard operations center*
- *Hardware and software necessary for the data transfer and processing*

The system constantly monitors the acoustic pressure level, including the meteorological conditions. The measured data are immediately transferred to a server where a correlation between the individual flights and noise events is made.

After that the data is saved. The flight paths than can be shown in 2D or 3D view to obtain the precise output, so the operator has very accurate results of every aircraft departing or arriving at the airport at any segment of time.

Of course the noise is and still will be the most disturbing and significant problem of every large airport located in the vicinity of any build-up area like Prague. From the text situated on the previous pages it is visible that every airport and in this case the Václav Havel Airport Prague cares about this problem and is trying to eliminate it as much as possible. Because of the very modern monitoring systems, communication between the airport and affected areas as well as modern aircraft and still stringent legislative the noise from the air traffic around the airport is decreasing. Also the relationships among the people living in the vicinity of the airport are better than in the past. Letiště Praha a.s. publishes so called Noise level measurements documents every year for public sector, so people are able to see what was happening during that year and whether the noise was within the limits or sometimes over these limits. It is also possible to find the main source of noise at any time and the most disturbing (loudest) air carrier operating at the airport.

### **3.3. Czech real estate market**

The real estate market in the Czech Republic is dependent mainly on people and their moods. These moods are highly influenced by domestic and foreign actions. Following paragraphs describe how these actions have been affecting the market during the year 2014 and the beginning of 2015.

## Foreign impulses affecting the market

Of course from this point of view, the real estate market is mainly influenced by the European Union and the actions around. Greek bad situation is getting better and calmer. New and large funds of the Eurozone are being made for the purpose of helping and saving the countries with serious economical and financial problems. Many countries of the EU registered a significant economic growth. There is also no expectation of elections in any of the strongest country, what probably means no change of the current EU direction and tasks. According to this EU will still continue in the way of common currency, common market, gradual federalization, common tax and government. Whole stability and flexibility of the bank sector that is very important for real estate market in the Czech Republic is going to be affected by the European Central Bank (ECB), large international banks and a headquarters of main domestic banks. Every monetary or financial change could negatively influence the real estate market in the country. The most important country currently influencing Czech market with real estates is Germany. There was and still is a significant economic growth in this country during the last years which of course supports a growth of the Czech domestic economy. <sup>[23]</sup>

## Domestic influences and impulses affecting the market

It is obvious that the domestic market is mainly influenced by economic condition of the Czech Republic and level of political stability. The market is very sensitive on any change of political and economic situation. There are new laws being used since January 2014. Most of Czech citizens see a big problem in constant tax increase and increasing public debt. In 2016 it is expected that the total debt of Czech Republic would be greater than 2 trillions of CZK. Households are influenced by a great increase of food price, energy and gasoline. Such price growth has a negative impact on the purchasing power of residents. For the real

estate market the willingness of banks for loans and the level of interest rate is crucial. Level of interest decreased to its historical minimum in 2013. It is a positive and welcomed change mainly for the people thinking and speculating about buying some real estate. <sup>[23]</sup>

Following part focuses and describes specific types of real estates that could be found on the Czech market. Readers are able to make their opinion what the real estate market consists of. Thesis is focused on the flats and houses mainly therefore main attributes affecting the price and value of such property, are also stated in the following text.

### Specific types of real estates on the Czech market

- **Older privately owned flats**

Price of older flats has been stagnating during the last two years and there is no significant change expected in this and the following one. Of course there could be some exceptions, especially in the very favourite and wanted areas like city centers etc. In general there is a highest demand for 2 kb (kitchen + bathroom) and 2+1 flats in the Czech Republic at the present time. <sup>[24]</sup>

- **Cooperative flats**

Price of those flats is supposed to increase and in the near future it is expected that such flats will be on the very similar price level as privately owned flats. Difference in price is currently between 8-20%. Reason of such price increase is change in the Civil code of the Czech Republic. <sup>[24]</sup>

- **Flats and houses under the ownership of Ltd.**

This kind of ownership is very popular and still growing, because of the tax reasons, mostly in case of new flats. On the other hand Ltd. is possible to create very

quickly, cheaply and quite easy today, it means these real estates are little bit risky. Lower price of those flats is expected in a horizon of 3-5 years because of the selling risk and still increasing mistrust of potential buyers. <sup>[24]</sup>

- **Family houses**

There is a significant impact of higher price of energy because the energy intensity of operation plays a main role at the present time. Enormous price increase of energy caused the fact that investors are more careful and they often focus on a smaller and well thermally insulated and equipped family houses. A sensibility of people on daily expenses is obvious. From this paragraph it is clear that large and ill-equipped houses are being sold in a lower price and the whole process usually takes a longer time. Prices of family houses are going to stagnate during this and following year, new and well-equipped houses could be eventually sold for a higher price. <sup>[24]</sup>

- **New houses**

Most of the developers still report that the prices of new houses are increasing but it is not true at all. It is obvious that there are a lot of such properties still available and unable to be sold in Prague and the Central Bohemia, while these are very lucrative and wanted locations. Constant discount events are also visible. Real estate market is getting cleaner and it is under control of a few largest developers. Supply of new houses is large and prices are on the interesting level at present. It was found that more than 20% of new 1 kb and 2+1 houses are being bought as an investment, not for a buyer's satisfaction. For potential buyers it is a right time today to buy a new house. <sup>[24]</sup>

- **Apartment houses**

This kind of houses is a scare commodity, therefore the price is still very high and there is supposed to be no change in the near future. Technical status of



apartment houses is of course very important. There is still more and more houses after great reconstructions therefore the price is getting higher. In case there was no reconstruction being done, potential buyers usually tend to buy more flats in a newly built house than to invest to the extensive reconstruction. <sup>[24]</sup>

- **Cottages**

After a five year long, continuous price fall it is getting to be again stable. This kind of property reacts to the market change the most quickly. During the last two years it is getting still more and more attractive to purchase a cottage especially for a middle-class people near the retirement age. Most of these people are changing their opinions about cottages. In the past it was a place for recreation during the summer period, for a weekends etc. Today older people see it as a place for their retirement period while their current property will be rented, sold or left to their children. <sup>[24]</sup>

- **Building or construction plots**

This type of property is still more and more demanded one. It is also obvious from the prices that are very high and still increasing. It again depend on the area where is the building or construction plot located but it is possible to note, that generally in the Czech Republic it is starting to be a scarce property mainly because of the size of the country. Most of the citizens see a great future investment in buying such property. <sup>[24]</sup>

- **Rents**

Price is almost constant and supposed to be slightly decreasing in a near future. The reason is a very high supply of rents especially in large cities like Prague, Brno or Ostrava. <sup>[24]</sup>

It is necessary to mention following information and facts to conclude this section. Economy of the Czech Republic is currently growing even that there are a

lot of problems and obstacles such as governmental wrong decisions, bureaucracy, pretty bad judicial situation etc. It is expected that the real estate market is going to be well developing of course if some significant change or problem will not occur. The market is mostly influenced by willingness of banks to lend, purchasing power and the mood of the population. It can be highly affected by any external shock or rapid change. An investment desire and courage of people to buy properties is dependent on law enforcement and fiscal and political stability. An indirect impact is also possible on a European level by the European Central Bank, because of a massive purchases of non-performing government bonds, especially of the southern states. Of course such factor will affect the market in the longer period horizon. So called "middle class" of society interested in real estate purchasing is still mostly influenced by domestic affairs and the development of the country which is getting worse during the last years.

### Factors influencing the property price

There are 10 most important factors significantly affecting the price of any property on the Czech real estate market. This paragraph focuses mainly on the price of flats and house because of the purpose of the thesis. <sup>[23]</sup>

#### **1. Locality**

The highest value is expected in case of flats or houses located in the city centers of large cities or very close to this area. In the Czech Republic such example is Prague or Brno, the two largest cities in the country. Very interesting is the center of Prague, where price is influenced mainly by the owners of flats, and they can absolutely manipulate with this price because of the profitability of the location. The capital city of the Czech Republic is currently the most lucrative area. Another very interesting and required location is a tourist known and desired area where for example a spa is located. It is also about the characteristics of such

location, whether the house or flat is located in a busy and polluted part of a town or whether it is in a calm and relatively clean district of the same town. <sup>[[23]</sup>

## **2. Size of flat**

People mostly think that larger flat means higher price. It is often the rule but there are some cases where this statement is not true. Size itself is not setting the value or price of the flat. There are other important factors that must be taken into account (such as locality, age of flat etc.). <sup>[23]</sup>

## **3. Ownership**

Basically the higher value and price have flats or houses in a personal ownership. But there are still some cases where a flat in a cooperative ownership can have a higher value. For example paid annuity can change the price significantly. At the present time the ownership has approximately 15% share on the final property price in the Czech Republic. <sup>[23]</sup>

## **4. House condition and used materials**

In case of flats it is important to consider also the condition of a house as a whole not only the condition of a flat inside this house. There are some examples where the flat is after complete reconstruction and its value should be really high but if such flat is located in an old house without any reconstruction, then the final price of the flat will be much lower than expected. Used construction or building materials also play a great role when setting the price. There is currently a higher demand for flats situated in a brick houses than in panel houses. <sup>[23]</sup>

## **5. Floor (where is the flat situated in the house)**

Price of flat is changing according to the floor on which is the flat situated in the house. Generally higher floor means higher price. There are two common rules. First floor or ground floor is usually not popular and often unwanted because

people are scared of crime and the second rule is about the last floor in a house. This floor is also not popular because of the proximity to the roof that could be in a bad condition and potential buyers are afraid about isolation (heat insulation).<sup>[23]</sup>

## **6. Services in vicinity of the house/flat**

On the sixth place of this rating chart there are services. It is really important to have supermarkets, schools, medical care or some playground in vicinity of the house or flat. Most of people are willing to pay for a flat or house in a location where most of these services are situated than to commute to somewhere because of shipping for example.<sup>[23]</sup>

## **7. Availability of public transport, road infrastructure and parking lots**

Right behind the services the public transport or parking lots availability must be considered. This is a problem of small towns or villages where is the poor availability of public transport. On the other hand big cities usually mean a high number of cars and this often results of a low number of parking spaces. A very good example is Prague. According to the research this could affect the price by 5%.<sup>[23]</sup>

## **8. Surrounding and view**

If the house is located in a very nice area with a lot of green around the price is supposed to be higher than in case of large factory or busy crossing right in front of the exactly same house.<sup>[23]</sup>

## **9. Type of flat and direction (orientation)**

During the last few years the highest demand is for 2 kb or 2+1 flats in the Czech Republic. It is impossible to say generally that flats 2 kb or 2+1 will have a higher value because of its type and number of rooms. Of course basically more rooms or larger flat or house means higher value and price. There are still some

cases where this statement is not true. It is absolutely a different situation if there are many rooms in the flat but these rooms are illogically arranged. Or if there is a walk-through room, bathroom accessible not from the hall but from some room only or a toilet situated together with a bathroom. All these factors can push the price. Change of price in a positive way (higher price) can be assigned to the terrace, balcony or a garden available. A lot of people are also interested in flats oriented to a specific cardinal point. <sup>[23]</sup>

## **10. Equipment**

It was already mentioned that flats or houses after complete or partial reconstruction have higher value and price than before or without any reconstruction. For some potential buyers it is also very important if there is some equipment in the house/ flat or even if the property is completely equipped. Of course this will be reflected in the price. <sup>[23]</sup>

## **4. OWN CONTRIBUTION**

### **4.1. Introduction and description of target locations**

For the purpose of this thesis locations were chosen according to the distance and direction to the airport. These locations are divided into three zones. “**zone A**” that comprises areas located at a very close distance to the airport. In a “**zone B**” there are villages or small towns (suburbs of Prague) located between 4 to 10 kilometers away of the airport but still supposed to be influenced by the airport traffic and operations because of their position. Those areas are placed directly on the track of final approach or on the departure paths. Therefore the influence by arriving and departing traffic should be noticeable. The third zone is a “**zone C**” where all the localities supposed not to be influenced by the Václav Havel Airport Prague are. It is expected that according to this form of division and proper

application of HPM, objective results should be obtained and the author will be able to achieve the final conclusion.

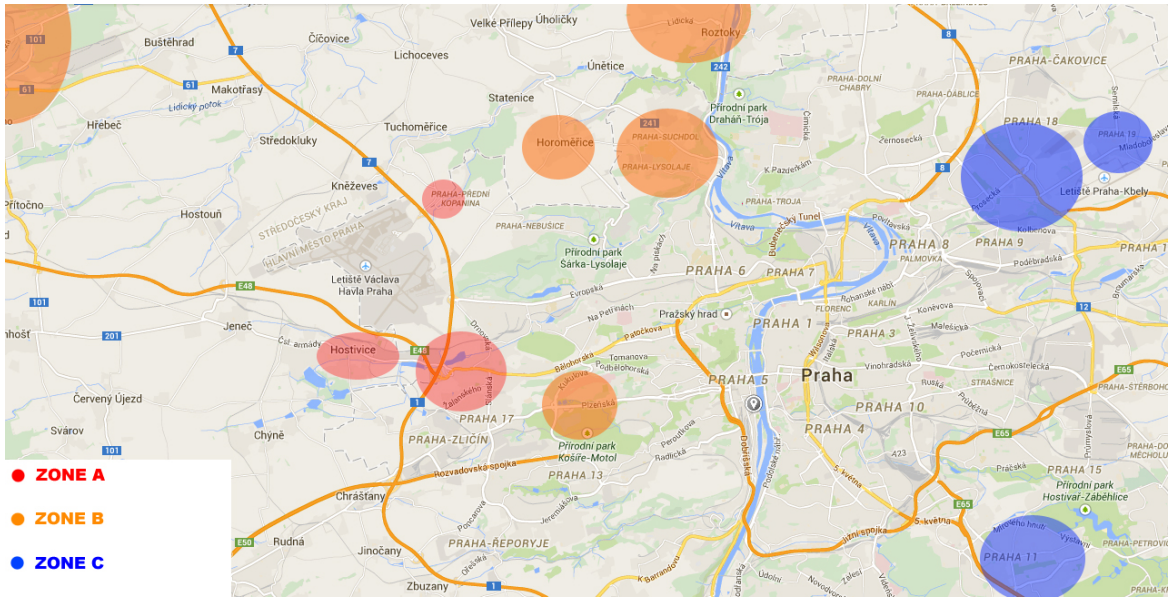


Figure 4: Location of areas involved into the project (zone A, B, C)

Source: Google maps [15], made by author

### 4.1.1. Locations supposed to be affected by the Václav Havel Airport Prague

#### Zone A (up to 3 km)

This first zone consists of locations very close to the airport and usually in the extended axes of the main runways. Four areas were chosen from this zone to be investigated.

- **Přední Kopanina**

It has been a cadastral territory and also part of Prague since 1990. It is located approximately 10 kilometers out of the city center at the northwest side. Fields together with forests form the larger part of this territory which is quite calm but the vicinity of the Václav Havel Airport Prague is dehortative for some people. The airport is located only 2 kilometers out of Přední Kopanina and to the busiest RWY 24/06. It means that arriving and mainly departing traffic is crossing this territory almost every day, if the runway is active. Because of the ascendancy of west winds, the RWY 24 is in use almost permanently. Otherwise there is a poor public transport connection between Přední Kopanina and other parts of Prague. There are only two bus lines currently. There is no kindergarten, primary or other school, because of a low number of inhabitants. Only about 750 people have their permanent address here. Most of the properties are family houses after reconstruction or newly built. The Church of Mary Magdalene is a historical object from the early 12<sup>th</sup> century. <sup>[21]. [25]</sup>

- **Prague Ruzyně**

Ruzyně had been an independent village until the year 1960 when it was joined to Prague. With an area larger than 15 km<sup>2</sup> it is the second largest part of the city immediately right after Horní Počernice. It has a long and fanciful history. There are several schools, primary as well as secondary, prison and the Research institute of Agriculture Engineering. Also many shops, supermarkets and warehouses are located here. Prague Ruzyně is connected with the international airport by a bus lines, there is also a very good railway connection between the city center (Masaryk railway station) and other cities situated north of Prague such as Kladno or Rakovník. Most of this area is covered by buildings. It is a mixture between family houses, urban settlements (where many flats are situated) and other type of buildings like warehouses etc. On the other hand there are some parks and distance to the nature outside the city is also very short. So it is still possible to

reach restful and calm place quite easily. The airport is situated 2 km away and Ruzyně is exactly in the extended RWY 30/12 axis. It means the arriving and departing aircraft are overflying the location at a very low altitude and the level of noise caused by this traffic is significant. The situation is still a little bit different comparing with Přední Kopanina, because RWY 30/12 is not the main runway, and it is active for a short period only or during special situations (reconstruction of the main RWY 24/06 or different wind direction requiring its usage). This is the first important reason of different situation to Přední Kopanina from the point of view of disturbing airport traffic. Another one is a different structure of the location, heaviest road and railway traffic etc. In this case the aircraft noise is not so disturbing than in a location where there is no railway, very low road traffic, and there are mostly family houses with a nice nature all around. [21], [25]

- **Prague Řepy**

Situated in the western part of Prague in Prague 6 district. There is a beginning of D5 highway leading to Pilsen, a city located in the west part of the Czech Republic. Řepy used to be a village since the 13<sup>th</sup> century it was connected to Prague in 1968. Since the 1980s a huge settlement has been built and reconstructed here. There are many places where people are able to do a sport (football, volleyball etc.), more than five primary schools and four secondary schools are located here as well as one university. Many shops and also a large supermarket can be found in Řepy. There is a large network of roads for road traffic, many bus lines, connecting this part of Prague with a city center, airport or other important places. Also a tram and train connection is available. There should also be an underground line from Dejvicka to Zličín in future. If compared with other locations involved in this project, Řepy is in a very similar position as Prague Ruzyně. The only difference is that this part of Prague is situated slightly out of the final approach and take-off track of RWY 30/12. It means that noise and other disturbing elements are less evident. Also the road and rail traffic is very heavy



here so people are complaining more about this problem than a problem with air traffic that is not so frequent. <sup>[21], [25]</sup>

- **Hostivice**

It is a town situated along the western border of Prague, belonging to the Central Bohemia and Prague - West district. It lies next to the road highway leading to Karlovy Vary. There are currently 7.8 thousand people living in Hostivice. There is an elementary and secondary school and also kindergarten located in this town. Small industries, services and agriculture prevail in the city. There are no big companies therefore residents commute to Prague or Kladno for a work. In case of transport there is a railway station in Hostivice founded in 1863. People can get to the center of Prague, Kladno and Rakovník, by using the train including express trains. There are also some bus lines connecting this town with Prague, Kladno and other villages and towns. In the north part of the town there is the Václav Havel Airport Prague located, therefore it is a job opportunity for some residents but also a disturbing element for some other. It is important to note that all the runways and taxiways used by aircraft at this airport are situated far away from the town and runways have absolutely different direction than leading to Hostivice. It means there is no arriving or departing traffic directly crossing the town or overflying closely. From this point of view the most significant disturbing element is a noise and pollution from the road traffic as well as from the ground operations at airport.

<sup>[21], [25]</sup>

### **Zone B (3 – 10 km)**

Towns and areas in this zone are supposed to be also affected by the Václav Havel Airport Prague but the expected level of noise and other pollution caused by air traffic should be lower or not so significant as in the zone A. There are again some locations that are a part of the capital city but also some towns, cities and

villages located outside the capital city. Again in some cases the author is focusing on the areas situated exactly or very close to the extended runway axis because of the highest level of pollution expected. Some locations are slightly outside this axis so there should be some difference in a level of disturbing noise etc. All of these areas are supposed to be influenced by the airport.

- **Horoměřice**

A village located on the northwest border of Prague in the Central Bohemia region. It is bordering with Suchdol, Nebušice, Lysolaje and Přední Kopanina. Horoměřice is situated in an open countryside next to the Šárka's valley. South and west of the village are lined with forests and green belts. There are also some streams, small ponds and rocks around Horoměřice. Currently more than 3 300 people live in this village. There are some basic shops, general practitioner, post office and a few restaurants. Horoměřice is quite known and favorite because of tourists, mainly for a weekend trips of Prague citizens. There are also some places where residents can do a sport. One main road connecting Prague and Kralupy nad Vltavou leads through the village. There is also a good road connection to the surrounded towns and villages such as Roztoky, Únětice, Nebušice or Přední Kopanina. In case of public transport the only possibility how to reach Horoměřice is by buses. The nearest train station is located about 6 km away. The Václav Havel Airport Prague is located about 5 km south-west of the village. The problem is that Horoměřice is exactly on the final approach and initial departure track of this airport. Aircraft approaching and departing are therefore overflying the village in quite a low altitude and in some cases on a take-off engine power. The noise and air pollution are therefore very significant here and it is considered as an important disturbing element otherwise the other traffic (road) is not so frequent here and there is mostly the green and forest nature around the village. Regarding this, people living in this location are often complaining about the air traffic caused by the vicinity of the airport.

- **Prague Suchdol**

It is a district and cadastral area of approx. 430 hectares situated in the north of Prague, on the left bank of the Vltava River, very close to Roztoky and Horoměřice. The most significant complex are buildings of Czech University of Life Sciences that are located in the south-west part of Suchdol. The nature is pretty similar to Horoměřice there are rocks, many green belts and forests in the vicinity. Currently more than 6.7 thousand people live in Suchdol. There are some shops, restaurants but still the most interesting and important facility is the university. This part of Prague can be again reach only by bus lines and there is also a railway-station located in Prague Sedlec, just 1 km out of Suchdol. People can reach the city center of Prague by train in less than 15 minutes. Part of the district is situated in the center of the extended axis of RWY 24/06 that means it is influenced by the air traffic similarly to Horoměřice. Aircraft are reaching their final track exactly over Suchdol and normally starting the final approach phase. The altitude is higher than over Horoměřice but still the noise is evident. An air crash happened here in 1975, when an aircraft full of passengers returning from Tivat fell out of the skies and hit the rocks and allotments over the river Vltava. Fortunately nobody from Suchdol was injured. People are again complaining about significant noise mainly during take-offs.

- **Roztoky**

Is a town located north of Prague on the left bank of the Vltava river very close to Prague Suchdol. More than 8 thousand people live here at present. There has been a significant increase of the inhabitants because of a massive construction of new flats in recent years. There is a building mix in Roztoky at the present time, it is possible to find a family houses, commercial building as well as old, reconstructed or newly build urban settlements. There are many historically interesting objects. Distance to the nature is very short, because the town is surrounded with it almost from all sides. Good road infrastructure is going through

Roztoky. The town can be reached by bus, train and car. Availability of public transport is nice here. Also the connection with the other side of the Vltava river is ensured by a small ferriage. With regard to the Václav Havel Airport Prague, the town is situated approx. 10 km northeast of it. Approaching and departing air traffic is noticeable here because it is also on the extended axis of the main airport's RWY 24/06. Aircraft overfly the town at an altitude about 1,200 m, it means that the noise and pollution is not as significant as in the areas nearby the airport such as Horoměřice, Přední Kopanina etc. Railway noise is often more disturbing than noise caused by the air traffic.

- **Motol**

The district of Prague located in the valley of the Motol stream. There are no large settlements or other building complexes like in other parts of the capital city. A lot of green nature (meadows) was here in the past. On this place there is a tram and bus depot, hotel, important hospital and a small settlement. The most famous buildings are hospital and crematorium at the present time. In the depot area there is a secondary school. It is a very important transportation hub for a neighbourhood like Řepy. The district is accessible by tram, bus and also underground line A, from Dejvická station that should be in use since the second half of 2015. The public transport is very well developed here. A new tram and maybe also a train line have been planning for the purpose of connection with the Václav Havel Airport Prague. The proximity of the airport is very similar to Horoměřice. Motol is approx. 5 km away of the airport. It is situated on the right side from the final approach and initial departure track, but there are still some complaints about the noise caused by air traffic in despite of the hospital etc. is located away of the extended RWY 30/12 axis. <sup>[21], [25]</sup>

## **Kladno**

A city located 25 km northwest of Prague with more than 70 thousands inhabitants. It is currently the 13<sup>th</sup> largest city of the Czech Republic and the largest one of the Central Bohemia region. There are many elementary schools, kindergartens but also secondary schools and a university. It has been one of the industrial centers of Bohemia. There were mines and steelworks located in Kladno. This heavy industry also caused damage to the local environment because the air pollution was and still is very significant in this area. There can be found almost all the types of building in Kladno. Large settlements, newly build flats, family houses but also many commercial buildings and other properties. The city can be reached by road, mainly by buses and also by trains because of a large railway infrastructure. Kladno is situated approx. 10 km away in the northwest of the Václav Havel Airport Prague. It is affected by departing and arriving traffic only while the RWY 30/12 is being used. In the case of using such runway aircraft must follow the departure and arrival tracks leading outside the city and normally have the altitude higher than 1 200 m, therefore the level of pollution and noise cannot be so significant. Otherwise the air traffic approaching and departing main RWY 24/06 have no impact on the location. <sup>[21], [25]</sup>

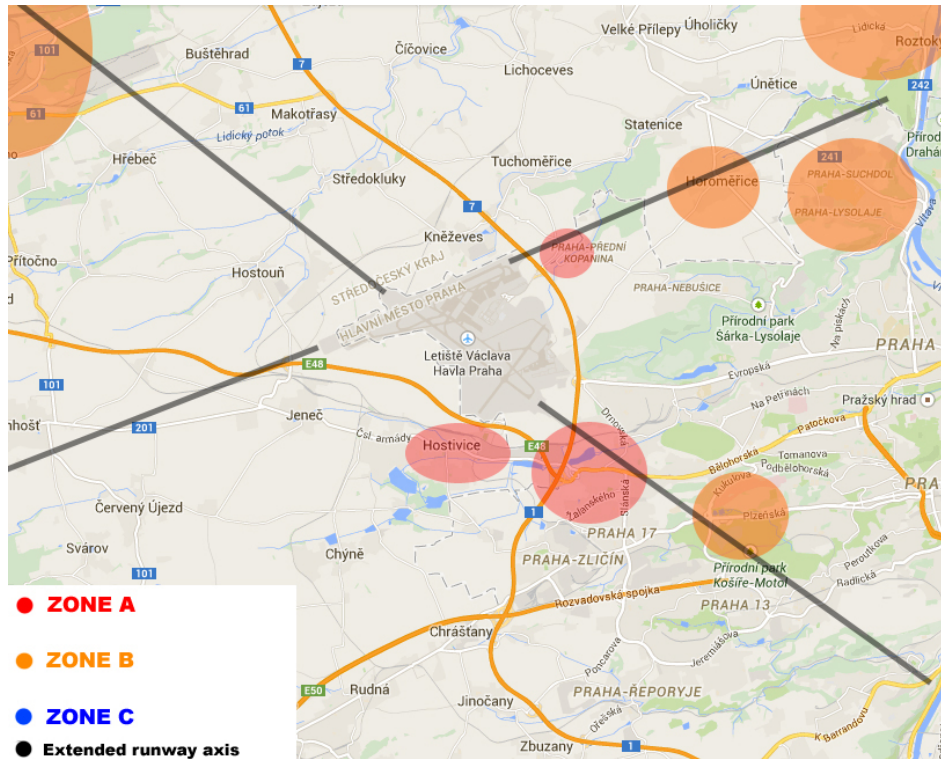


Figure 5: Airport chart with a highlighted extended axes of all current runways

Source: Google maps <sup>[15]</sup>, made by author

#### 4.1.2. Locations supposed not to be affected by the Václav Havel Airport Prague

**Zone C (15 – 20 km away from the airport, outside the air traffic corridors)**

Districts of the capital city Prague are involved in this zone. To provide an objective comparison of the Václav Havel Airport Prague influence it is necessary to focus also on the area that is far away from the airport and out of any runway axis and arrival or departure corridor. Therefore three locations were chosen by

author. These locations are very similar to areas (towns, villages or cities) contained in zones A and B. However the locality is completely different. Some of them are situated on the opposite side of Prague, another are quite nearby but in areas not influenced by the airport. Also the availability of transport, type of buildings or properties as well as landscape profile and accessibility of public services should be very similar to areas in A and B zones.

- **Kunratice (Prague 4)**

Prague neighborhood and cadastral located in the southeastern part of the capital city since the year 1990. During the recent years (2005 - 2008) the main road going through Kunratice as well as main parts of this cadastral area has been completely reconstructed. There is also a small settlement called Flora between the large forest (Kunratický forest) and dormitories of the University of Chemical Technology. From the point of view public transport only bus lines are available here, but it is not a problem, because of the very frequent connections and proximity to the underground line C. Kunratice is located absolutely on the opposite side of Prague comparing with the airport. There is no possibility of influence this area by the noise caused by air traffic approaching and departing the Václav Havel Airport Prague. On the other hand, significant road traffic is here. [21], [25]

- **Letňany and Prosek (Prague 9)**

Both of these localities are part of Prague 9, situated in the north of this city. It is well known because of the dominant settlement from the early 70ties of the 20<sup>th</sup> century. This settlement consists of a lot of flats located in the Prosek area. There are also some newly constructed small settlements and some family houses. A lot of supermarkets, office buildings and some other shops and public facilities are available there. Letňany was originally founded in 1307 and since 1968 it has been a part of Prague 9, same like Prosek. This district of Prague is very famous

because of the aircraft industry. There are two large factories located in Letňany – Avia and Letov. It is still in use but the industry has been gradually declining during the last years. Today it is more the residential area with a lot of family houses, new and modern settlements. However there are still two airports in use at present. The first one is a non-public international airfield Letňany that is used only for small general aviation aircraft and serves mainly for the training purposes. The second one is a military and governmental airport Kbely located approx. 3 kilometers southeast of Letňany district. A very good public transport network is established here. Prosek and Letňany are connected by bus lines, underground lines and as well as tram lines with other parts of the city. Road traffic (cars etc.) is very heavy here. <sup>[21], [25]</sup>

## **4.2. Internal data gathering and analysis**

The author decided to cooperate with one of the famous and largest real estate agency with a great tradition in the Europe and over the world. RE/MAX (Real estates maximums) is the international company operating in the field of real estate market and it works on the basis of franchising. It was found in Colorado, in the year 1973 by Mr. Lininger and his wife.<sup>[24]</sup> Most of the data for the purpose of the thesis was collected by the author, in cooperation with a real estate broker, who is also one of the author's consultants. Three important locations were selected and introduced in part 4.1. as target zones A, B and C. One of the requirements was to choose locations with an identical or very similar characteristics and specifications. Of course in the real world this is impossible despite of the fact the author was working really hard on this problem. On the other different characteristics of the locations as well as the infrastructure etc. there is the factor affecting the price significantly and must be considered while working with hedonic pricing method.



About thirty flats and houses for sale were chosen in every zone to put them into the model. In total this means that the author got the result of ninety flats and ninety houses from all the locations. While every zone and its locations were described in the previous chapter. In case of houses and flats the internal characteristics are very important. Only properties with the same or very similar size of m<sup>2</sup> are involved into the project. In case of flats only 3+1 or 3 kb in some cases also 2+1 but very rarely were chosen. Houses are another type of property in this thesis. Mainly houses with an area between 200 and 300 m<sup>2</sup> are contained. Following factors that were supposed to affect the price were investigated for flats:

- **Area**
- **Type of flat**
- **Floor**
- **Reconstruction or status of the flat (newly built)**
- **Furnishings**
- **Ownership**
- **Garage**
- **Elevator**
- **Terrace/ Balcony and its area**

Houses are the second type of the examined property. Again the objective was to target on the houses with a very similar size and type. From the data collected some outputs are very clear and show what makes the value different. The following attributes are important for the research purposes in case of houses for sale:

- **Area**
- **Number of rooms**
- **Reconstruction or status of the flat (newly built)**
- **Type of wall**
- **Garage**
- **Garden or terrace**

Only the family houses were examined in the project. Status or the type of the house seems to be the most important for the setting of the value of the house. Potential buyers would probably be very interested in the location, infrastructure, surroundings etc. But all of this belongs to the external and environmental factors affecting the market value and price. In the paragraphs on the previous pages only the internal attributes and factors were introduced and briefly described.

The data was collected and then transformed into the Microsoft Excel where special tables were made. All of these tables are attached in the supplementary part of the thesis. Right from this research it is obvious some items (factors) are affecting the price more while some of them absolutely not.

For the exact and absolute result whether it affects or not the price of the property the statistical tool called correlation analysis was applied. The correlation analysis is a tool testing the relationship (mostly linear) between independent and dependent variables. The dependent variable is in case of this research price of flat or house (price of the property). Emphasizes the strength or tightness of such relationship but do not examine the reasons and outcome of this relationship. There are usually three basic types of dependence between variables <sup>[3]</sup>:

- **Functional**– only one value of explanatory variable is corresponding.
- **Stochastic**– the functional relationship is  $E(y) = f(x)$ .
- **Independence**– explained variables  $y$  changes randomly regardless of the explanatory variables. It is impossible to write a functional dependence accurately. <sup>[3]</sup>

From the measured values was then necessary to find out whether the dependence of the price of flat as a dependent variable and flat characteristics as independent variables is conclusive. It means how tight is the dependence from the statistical point of view. For this purpose the correlation coefficient is important. This coefficient is shown by the number in interval between -1 to +1. If the absolute value equals number 1 it is called the functional dependence. If the resulting number is 0 there is independence between variables. What is also necessary is to compare the coefficient of correlation with a critical value of coefficient called  $r_c$ . This value is set for a specific level of significance while this level is being set according to the tables. The author was comparing the value with the critical value of the level of significance, which is 0.05 in this case, after finding the correlation coefficient for all the attributes supposed to be affecting the selling price. If the measured number is higher than the corresponding critical value it means that such attribute influences the price significantly.

#### **4.2.1. Correlation analysis of the internal attributes of flats for sale**

In this subchapter the correlation analysis of flats for sales is introduced and described. The author focuses on the internal attributes of each flat to find out the effect on the selling price. The Table 2, on the following page shows the parameters set by the author for measuring the correlation.

DEGREE OF FREEDOM	SIGNIFICANCE LEVEL	CRITICAL VALUE ( $r_c$ )
90	0.05	0.205

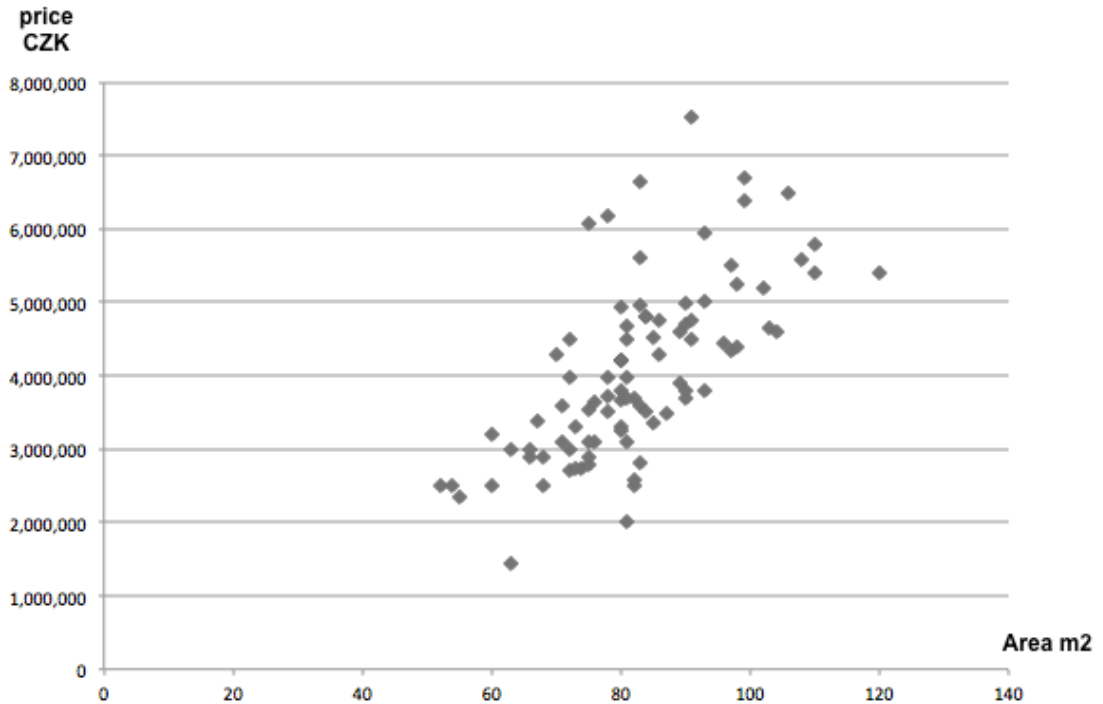
**Table 2: Table with the critical value of correlation coefficient of the flats for sale**

*Source: MS Word by author with using the statistical tables <sup>[3]</sup> <sup>[10]</sup>*

Ninety flats are involved into the research therefore the degree of freedom is 90. According to the statistical tables for this type of correlation the critical value 0.205 was selected as the proper one in case of the significance level 0.05. A comparison of each attribute is now described in the following part of the thesis and also the result, how well these attributes fit to the model and influence the selling price. Examined internal characteristics of flats were investigated one by one and the main purpose was to find the correlation coefficient ( $r$ ) for each of the attribute of the internal characteristics of every flat.

The correlation analysis, done by the author showed that the most significant impact on the selling price of a flat has the area of flat. Values are in  $m^2$  and it was collected in cooperation with the company RE/MAX<sup>[24]</sup>, and Sreality.cz<sup>[25]</sup> webpage available on the Internet. The higher is the area, the higher is also the price of the flat. The correlation dependence is visible in the following graph (Figure 6). The coefficient of correlation is  $r = 0.674$ , which means that it is absolutely above the measured critical value  $r_c$

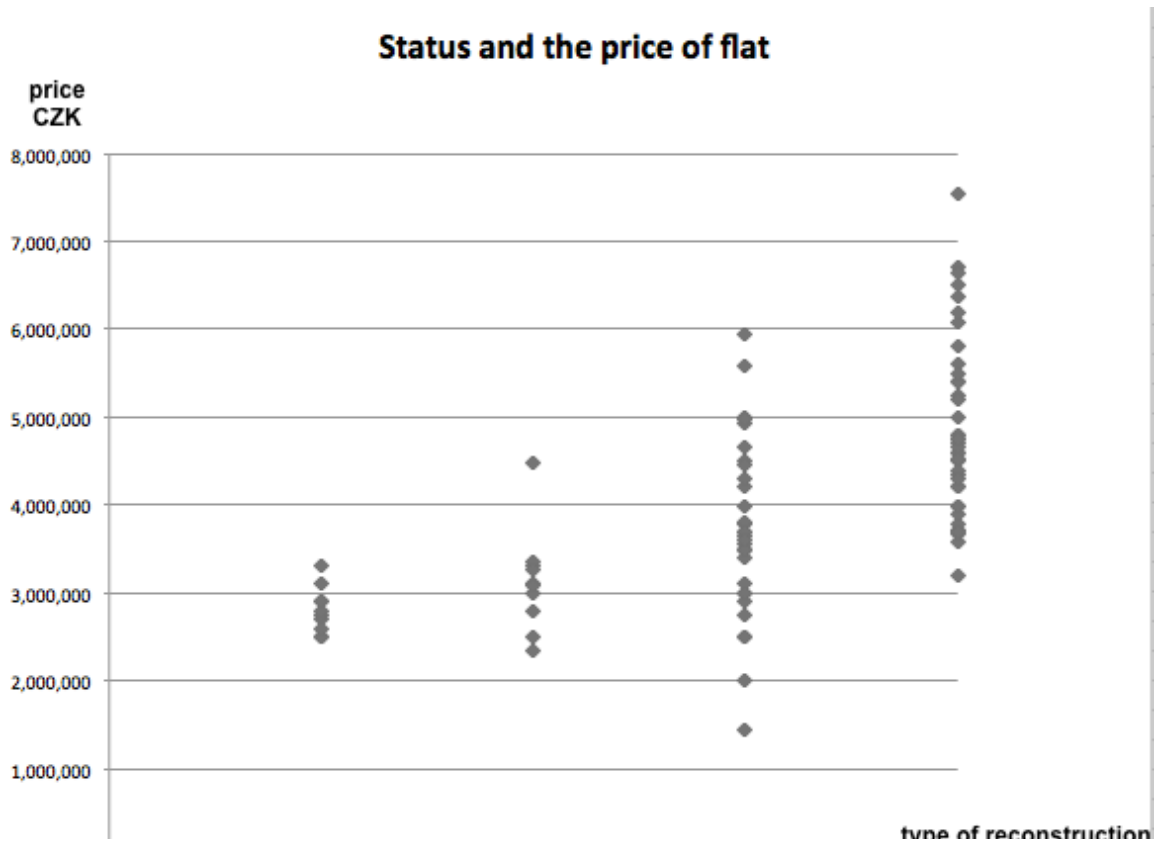
### Correlation between the area of flat and the price of flat



**Figure 6: Correlation dependence between the area and the price of flat**

*Source: MS Excel by author*

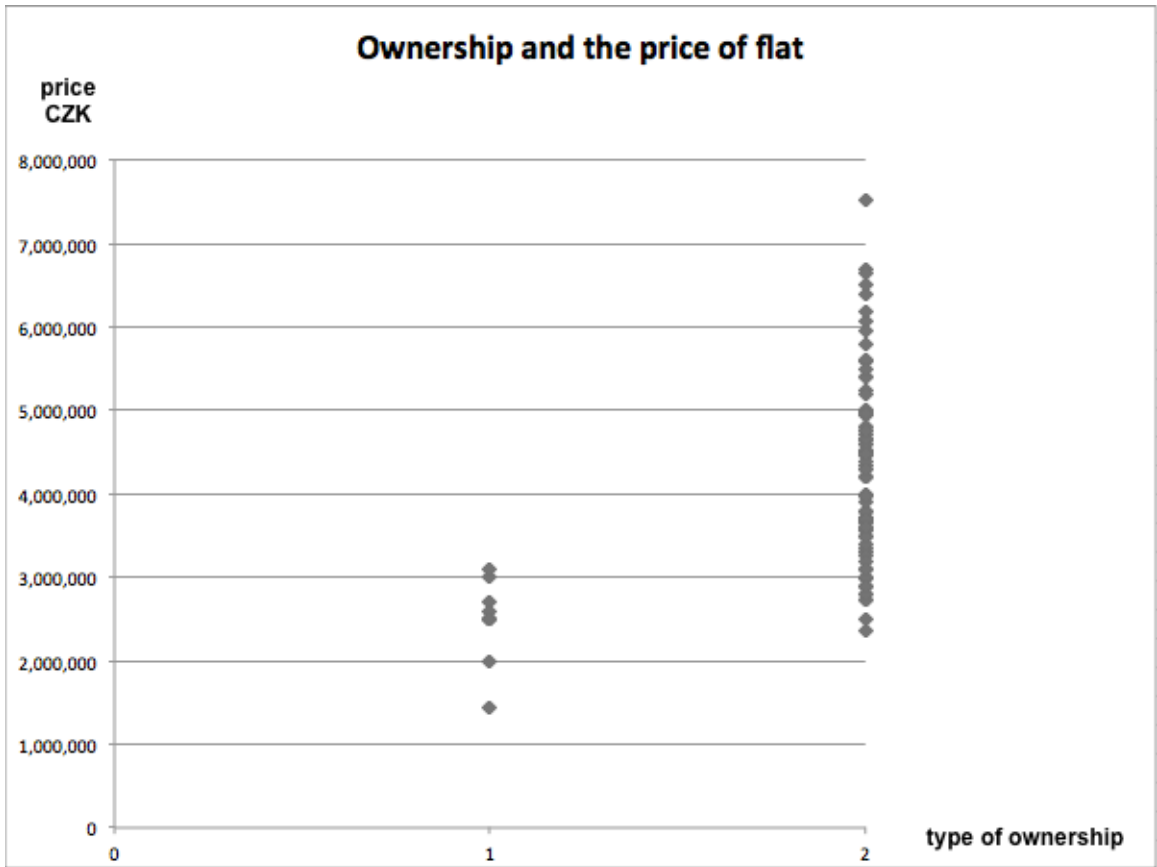
In the second place there is a flat status, whether the flat is newly built, reconstructed or before the reconstruction. It also rapidly influences the price. The coefficient of correlation reaches the following value,  $r = 0.630$ . It shows that it is also above the stated critical value of the significance level of correlation. Reconstruction was examined in every case of every flat in all the locations. It was marked by number 1 to 4, where one means no reconstruction of the flat or the building where the flat is located and 4 means a very new building. Again the building after large reconstruction or newly built objects are being sold for a higher price.



**Figure 7: Correlation dependence between the status and the price of flat**

*Source: MS Excel by author*

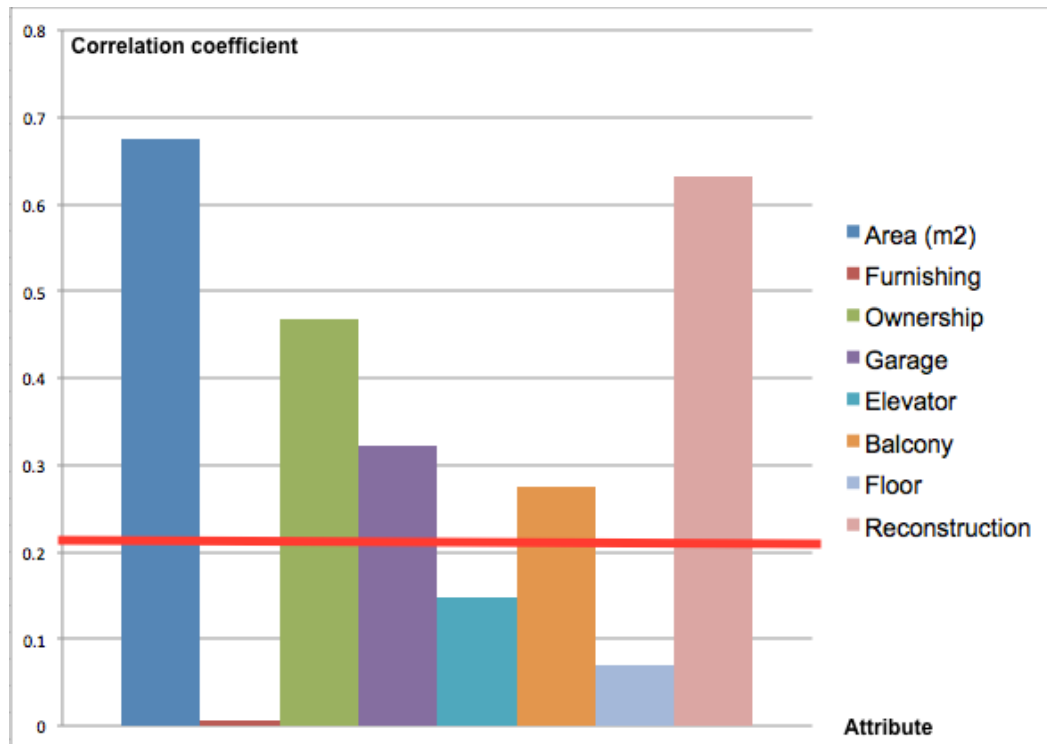
The ownership is the third factor that affects the selling price rapidly. There are two types of ownership again marked by numbers. Number 1 means flats under the cooperative ownership and 2 is for privately owned flats. From the research it was found that the correlation coefficient is in this case  $r = 0.468$ . Again above the set critical value but lower than the previous attributes. According to this it is obvious that personal ownership means higher price of the flat. It is also logical that flats in personal ownership are more favorite in the Czech Republic because of no rent and lower additional fees. The graph is visible on the next page (Figure 8).



**Figure 8: Correlation dependence between the ownership and the price of flat**

*Source: MS Excel by author*

There were much more attributes in the project involved and examined. All of them can be seen in the supplementary part at the end of the thesis. There are all the tables attached to this part so readers can focus on them more in detail. For the completeness of outputs and forming the results, the number of correlation coefficient of each internal attribute is visible in the graph on the following page. The critical value  $r_c$  is highlighted by the red color. Each attribute has a different colour so the graph is easy for orientation.



**Figure 9: Values of the coefficient of correlation of all the examined internal attributes of flats**

*Source: MS Excel by author*

#### **4.2.2. Correlation analysis of the internal attributes of houses for sale**

Again the correlation analysis as a useful statistical tool was used in this subchapter for the houses for sales internal characteristics. The purpose is very similar to the previous subchapter. The author is testing the correlation between each internal attribute and the selling price of the house. Only the family houses are part of the testing. Degree of freedom, significance level and the critical value is still the same as in case of flats for sale. The reason is that the number of houses observed is same. It means ninety houses from all the locations in Prague and around this city are involved in the analysis. The source for the data finding



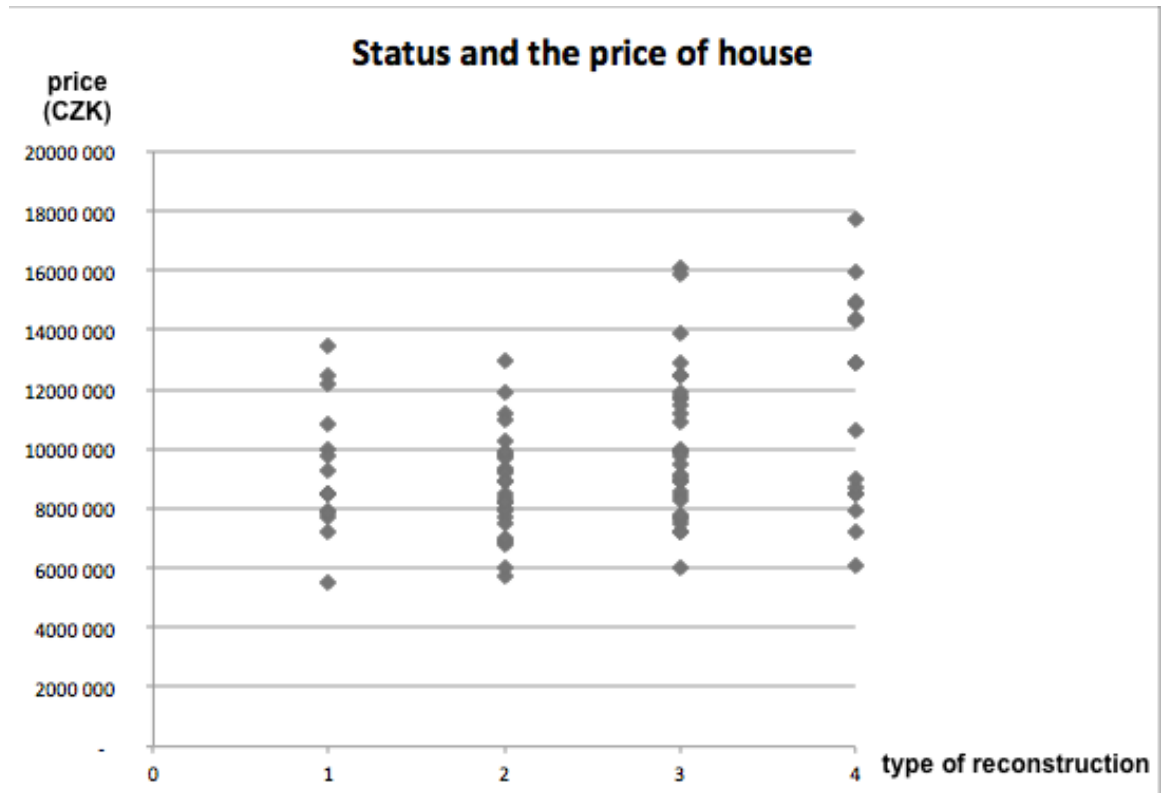
was again company RE/MAX introduced on the previous pages and Sreality.cz webpage.

DEGREE OF FREEDOM	SIGNIFICANCE LEVEL	CRITICAL VALUE ( $r_c$ )
90	0.05	0.205

**Table 3 : Table with the critical value of correlation coefficient of the houses for sale**

*Source: MS Word by author<sup>[3][10]</sup>*

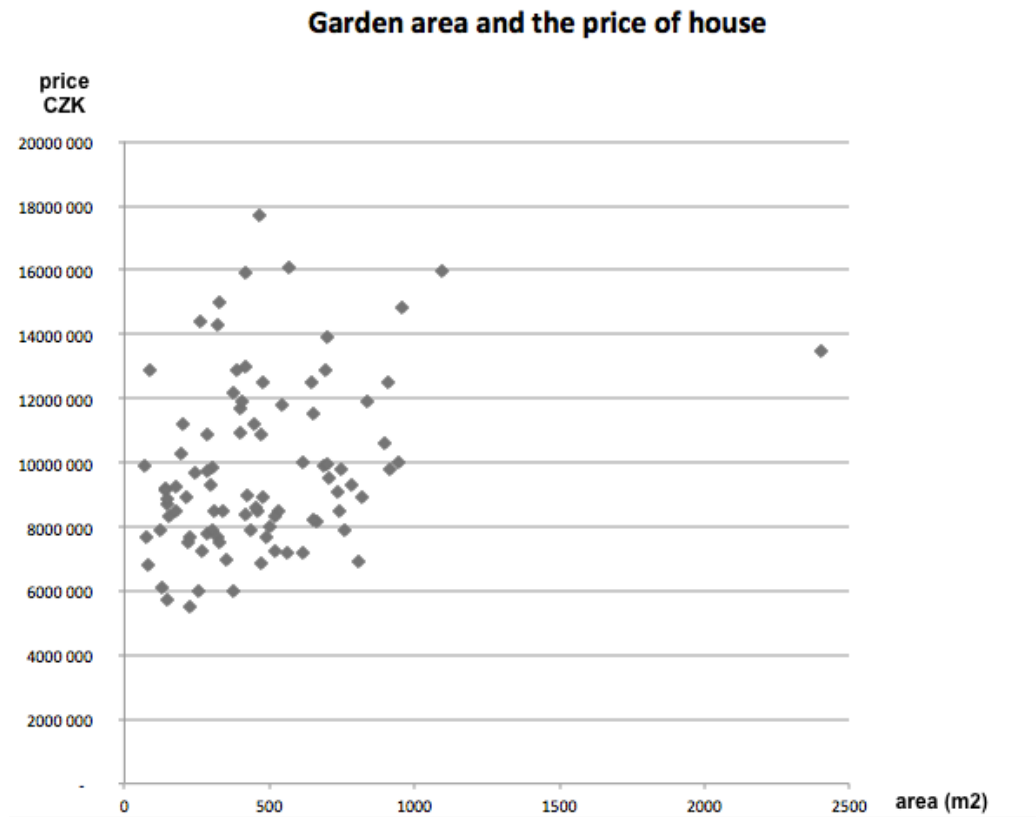
Correlation analysis showed different results than in the previous case. While for flats the most influencing factor is the area of flat, in case of houses the main attribute affecting the selling price is the status. If the house is newly built it is supposed to be sold for the highest possible price. Also if there was a complete or a large reconstruction, the price is very high again. The price is getting lower with a partial reconstruction or no reconstruction of old buildings. The coefficient of correlation between the status of the house and the selling price is 0.315 and this is above the set value of 0.205 of the level of significance 0.05. From the Figure 10 it is evident, that in case of every house, the status is explained on scale from 1 to 4. Again the lowest number means no reconstruction while number 4 stands for the newly built house. Most of the houses from the examined field are either partially reconstructed or after the complete reconstruction.



**Figure 10: Correlation dependence between the status and the price of house**

*Source: MS Excel by author*

Another high value of the coefficient of correlation was reached in case of analysing the dependency between the selling price and the garden area. All of the involved houses dispose of a garden. In average the garden area of all ninety houses is approx. 480 m<sup>2</sup>. The largest area was found in case of one house where this area is about 2 500 m<sup>2</sup>, but the house is in bad condition with no reconstruction, no garage etc. Therefore the final price is not the highest one. Most of the houses have a garden with size between 150 and 400 m<sup>2</sup>. Correlation coefficient is 0.309 in case of the garden area. It is also above the set critical value therefore it is very significant. All the details are visible in a Figure 11.

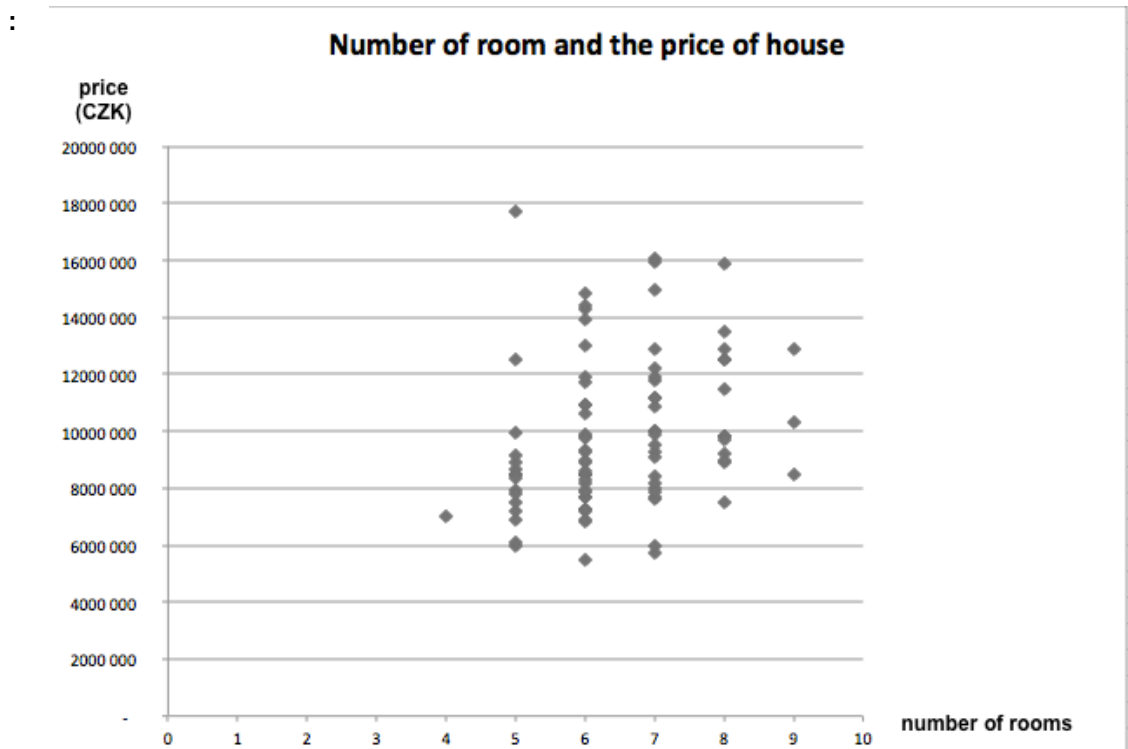


**Figure 11 : Correlation dependence between the garden area and the price of house**

*Source: MS Excel by author*

Only the three most significant internal attributes of examined houses are introduced and described in more detail in this part of the thesis. It was the same in case of flats, because the main purpose is to find out whether the properties are affected by the Václav Havel Airport Prague, only the most important internal attributes are stated. The author is focusing more deeply on the airport influences, mainly the noise as the most disturbing factor in the next part of the thesis. The third selected attribute is the number of rooms in the house. It has been proven that a higher number means a higher selling price. The coefficient of correlation reached the value of 0.269. This value means again a significant dependency

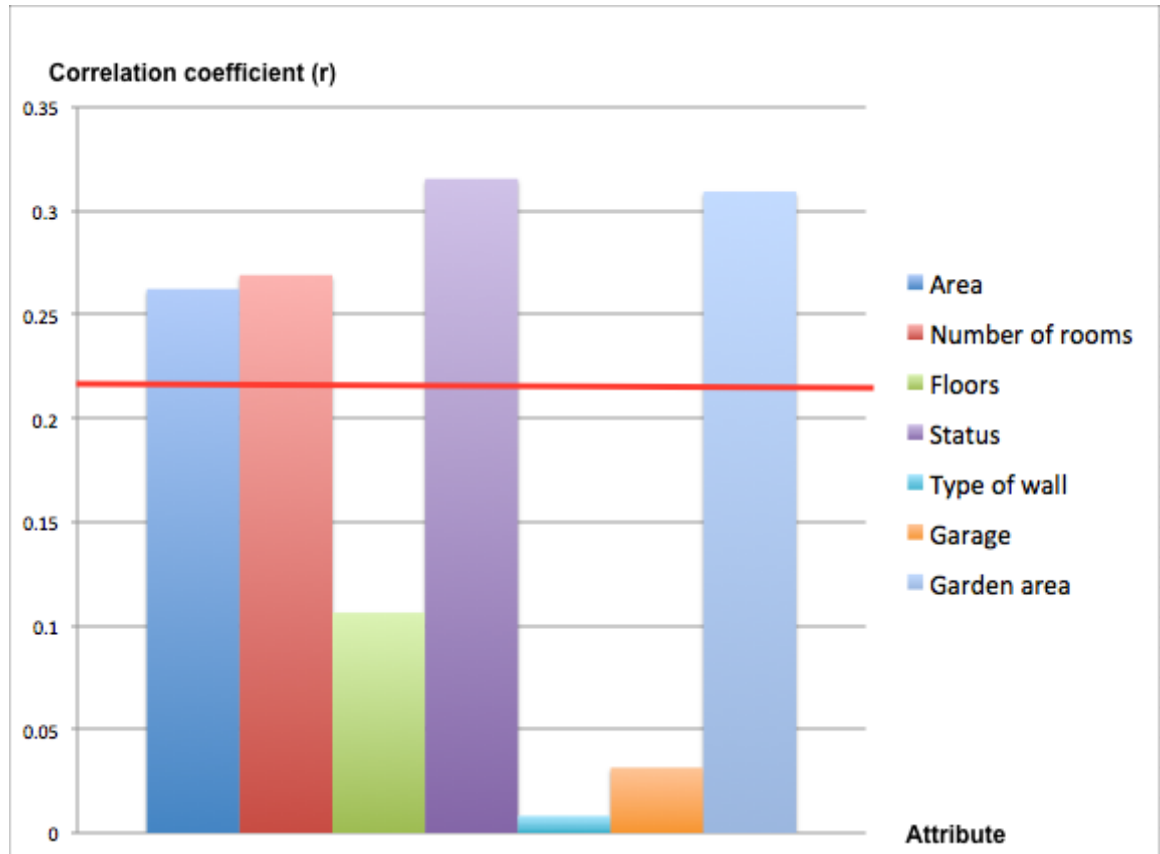
between the number of rooms and the price of house. Number of rooms is between 1 and 9. Most of the houses have between 6 to 7 rooms. This is again visible in the following Figure 12 below this paragraph.



**Figure 12: Correlation dependence between the number of rooms and the price of house**

*Source: MS Excel by author*

As in the previous chapter where the analysis of internal factors affecting the flat prices is, also in this part the graph showing a complete set of internal attributes is attached. Figure 13 shows all the examined attributes, correlation level and the dependency between the price of house and every single attribute. Again the critical value 0.205 is highlighted by the red colour for a better understanding.



**Figure 13: Values of the coefficient of correlation of all the examined internal attributes of houses**

*Source: MS Excel by author*

Due to the subchapters 4.2.1 and 4.2.2. the internal characteristics influencing the price of property are now clearly visible and described. The most important attribute was selected as the main factor affecting the property price for both cases – flats and houses. From the target analysis it is obvious that there are different internal attributes affecting the selling price in both cases. While in case of flat the price is mostly dependent on the area of flat in  $m^2$ , in the second case, the price of house is mainly dependent on the status of such house. The area is on the second place right behind this status in this case. On the basis of this fact it is therefore

possible to sort the properties to the homogenous groups according to the main attributes (area and status) for the purpose of HPM.

### 4.3. Environmental data analysis and the HPM application

As the main environmental factor influencing the quality of living but mainly the selling price of flats and houses in the target locations, the airport noise was selected. For the purpose of the analysis of such factor the noise chart of Prague was used to compare the noise level in every examined location involved in the research. All the locations are described in the previous parts of the thesis especially in the subchapter 4.1. This was the only possible way, how the author was able to collect the environmental data – noise data. In the table 4., immediately below this paragraph the level of noise shown in decibels (dB) is illustrated.

<b>Zone</b>	<b>ZONE A</b>	<b>ZONE B</b>	<b>ZONE C</b>
<b>Average noise level during the day (dB)</b>	<b>58.6</b>	<b>55.15</b>	<b>54.5</b>

**Table 4 : Average noise level of examined zones during the daytime**

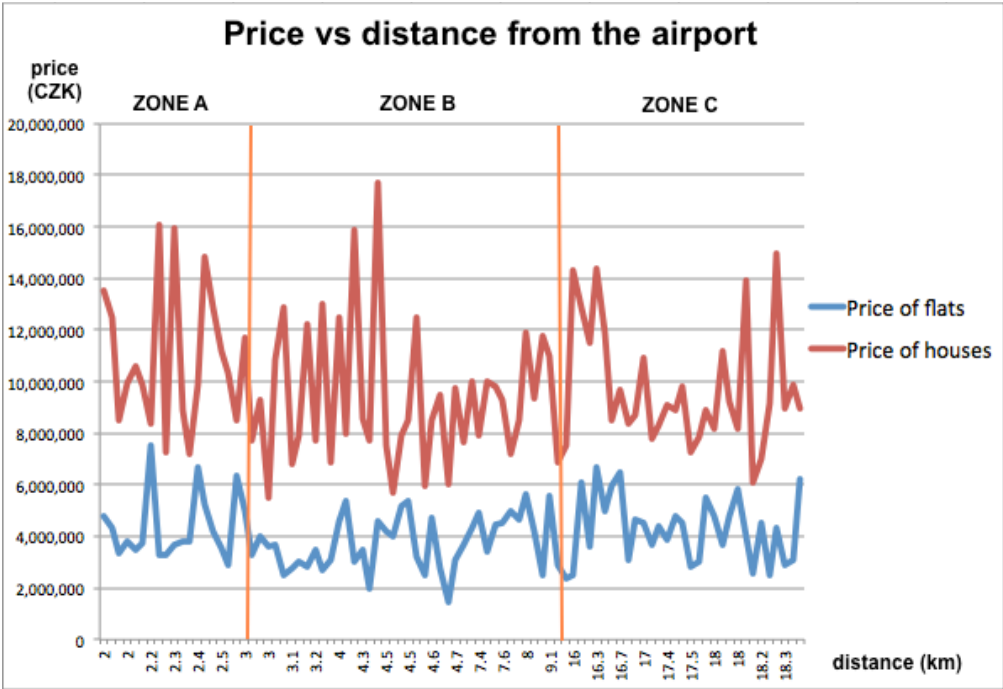
*Source: Noise and environmental monitoring by Letiště Praha a.s., Noise chart of Prague<sup>[12], [21]</sup>*

The table made by the author by using the information from Letiště Praha a.s. and the official noise chart of the Prague city illustrates the differences in the three examined zones. Only the data of the daytime (6:00AM – 10:00PM) noise burden were taken into account for this analysis. The reason is that during the daytime the level of noise is usually higher than during the night (10:00PM – 6:00AM), so the

price of the real estate should be influenced by the noise during the day. Letiště Praha a.s., as the Václav Havel Airport Prague operator publishes the documents called “Noise level measurement” monthly. Data published in these documents is considered in the research. One of the “Noise level measurement” output is attached in the supplementary part of the thesis so readers are able to see it. From these diagrams it is obvious that the level of noise produced by the air traffic is different according to the seasons of the year. It is connected with the level of traffic, number of aircraft operating to and from the airport. Therefore the author is comparing two seasons of the year, winter and summer season. It is because the summer season is also the main season, when the air traffic is heaviest. In the diagrams (Supplement 5, Supplement 6) attached at the end of the thesis, it is visible that the level of noise is very similar in both cases, but in July 2014 the noise is rapidly higher during the nighttime. The reason is that some low – cost, and most of the charter carriers operate their flights late in the evening or shortly before the midnight. These are the typical charter flights departing from Prague to North Africa and the Near East. In February the noise level reaches lower dB but also there is almost no difference between the day and nighttime, the values of dB during the nighttime are even lower. It is clearly visible that the noise burden is heaviest in the zone A, which is very close to the airport. Zone C, located the farthest and outside the arrival and departure corridors has also the lowest level of noise measured. This seems to be caused by the Václav Havel Airport Prague. The question is whether this fact also influences the price of the real estates located in these areas, which is also the main objective of this thesis. As mentioned before the hedonic pricing method is applied for the appropriate result finding.

Before the HPM will be applied in the next subchapter, the author tried to find the dependence between the selling price and the distance from the airport. This was again done by the correlation between these two variables. The results of correlation are visible in the following text part.

There are three zones being examined. Every zone is in the different distance from the airport and in the different location in or outside Prague. At first the graph was made by MS Excel to compare whether there is some significant visible dependence between the price of house or flat and the distance from the Václav Havel Airport Prague. The graph shows a result, that no such dependence has been found in this case, the price is fluctuating independently to the distance.



**Figure 14: Dependence between price and the distance from the airport**

*Source: MS Excel by author, distances measured by Google maps [15]*

### 4.3.1. The impact of the airport noise on the selling price of flats and houses

In this subchapter the impact of noise as the external environmental factor is examined. For this purpose, the author needs the characteristics of the real estate market that is in this case divided into three zones. Internal attributes of the properties and their impact on the selling price and the finally the selling prices of



flats and houses gathered in cooperation with RE/MAX company. As soon as all the data was collected and processed, the HPM can be now applied. The principle of the method can be summarized by the following statement. If any other factors are expected as constant (changeless), the price change is then dependent on the change of the examined environmental factor, which is in this case the airport noise. The equation is as follows:

$$\Delta P(p) = f(s_1, s_2; s_n, n_1, n_2; n_n; \Delta e) \text{ [1],[4]}$$

Where  $P(p)$  is the change of the property price and it is supposed to be the dependent variable. All other variable on the right-hand side of the equation are so called independent variables. For the purpose of the objective results finding, only the properties with a very similar specifications were selected. Otherwise it would be impossible to find out the dependency between the noise caused by the airport and the property price. Because of the result in the subchapter 4.2.1. it is obvious that the most important attribute affecting the price of the flat is its area in  $m^2$ . In case of houses, the main attribute affecting the price from the internal point of view is the status of the house. On the basis of these results flats and houses are divided into several groups in the following part of the thesis. Only by this way the objective dependence between the level of noise and the selling price can be found. In both cases the standard deviation was also tested. The reason is because of the very similar variance in case of all flats and houses. For the purpose of this research only the 10% maximum variance of the selling price was set in both cases.

## **Analysis of flats for sale by HPM**

There are three main steps of applying HPM by this analysis. At first the standard deviation has to be set. Flats were divided into three main categories according to their area ( $m^2$ ) and also according to the zone to which they belong. The standard deviation is visible in the following Table 5.

Flat area (m <sup>2</sup> )	Location		
	ZONE A	ZONE B	ZONE C
<b>50 – 75</b>	307	308	371
<b>76 – 95</b>	296	263	333
<b>96&gt;</b>	143	227	282

**Table 5: Standard deviation of each category of flats for sale**

*Source: MS Excel by author*

The next table shows the data considering the level of noise during the daytime, area of flat and the average selling price of each location. It is the mean value in both cases.

Flat area (m <sup>2</sup> )	Flat location					
	ZONE A		ZONE B		ZONE C	
	Average price (CZK)	Noise level (dB)	Average price (CZK)	Noise level (dB)	Average price (CZK)	Noise level (dB)
<b>50 – 75</b>	3 010 875	68	2490000	56	2 889 000	53
<b>76 – 95</b>	3 823 000	58	4 185 000	55,6	4 395 000	52
<b>95&gt;</b>	4 800 000	51	5378000	54	5 450 000	58

**Table 6: Mean values of price and level of noise within all three zones according to the flat size**

*Source: MS Excel by author*

Flat area (m <sup>2</sup> )	Flat location					
	ZONE A		ZONE B		ZONE C	
	Δ price	Δ noise level	Δ price	Δ noise level	Δ price	Δ noise level
50 – 75	-1.03	-1.01	1.04	1.02	<b>-1.02</b>	<b>1.03</b>
76 – 95	<b>-1.03</b>	<b>1.02</b>	<b>-1.19</b>	<b>1.01</b>	-1.09	-1.02
95>	<b>-1.18</b>	<b>1.10</b>	-1.09	-1.01	<b>-1.04</b>	<b>1.04</b>

**Table 7: Change in price and the level of noise in comparison to the mean values (flats)**

*Source: MS Excel by author*

What is obvious from the above stated table, are the differences among mean values of price and noise and the real values of every flat in each target location. What is important for the purpose of this analysis is the dependence between the price of flat and the noise in the specific location. The author is only interested in flats where a significant increase of the noise level and a significant decrease of the property selling price is proven. These results are highlighted by a **bold** font and a green colour in the Table 6. The main consideration is given to the zone A and the zone B where in the zone A, two results are significant and one result is significant in zone B. There are two more positive results in case of zone C. They are highlighted by the bold font but not by the green color because these results are not interesting for the purpose of this research. If there is some dependence between the selling price of flat and the noise in this area it is not caused by the Václav Havel Airport Prague, because all the locations within this zone are out of the arrival and departure corridors and far away from the airport. In this case the

reason is different (heavy road traffic because of the proximity of highway in Prosek and Letňany, proximity of factories etc.). In case of the zone A the direct dependence is proven in case of houses with are between 76 and 95 m<sup>2</sup>. On the other hand, this is the only one zone, where such direct dependence has been proven by the research. In the case of zone B only the flats of size between 76 and 95 m<sup>2</sup> can be marked as significant. All the other results must be rejected according to the main hypothesis. For the absolute confirmation of the results correctness, the correlation analysis was done by the author. Only the positive results were taken into account and investigated.

Again the significance level was set to 0.05 and the critical value ( $r_c$ ) was calculated for each variable as the first step.

Flat area (m <sup>2</sup> )	Location			
	ZONE A		ZONE B	
	r	r <sub>c</sub>	r	r <sub>c</sub>
<b>76 – 95</b>	- 0.184	<b>0.414</b>	0,276	<b>0.714</b>
<b>96&gt;</b>	- 0.503	<b>0.643</b>	<b>X</b>	<b>X</b>

**Table 8: Coefficient of correlation according to the flat size for zone A, B  
(flats)**

*Source: MS Excel by author*

Table 8 shows the coefficient of correlation between the change in selling price and the change in noise level according to the Table 7. Two different locations supposed to be affected by the Václav Havel Airport Prague were involved in this analysis. There was no significant correlation between the selling price and the noise statistically proven. As visible in the Table 8, the correlation coefficient of every investigated flat does not fulfil the criterion, it means r is in every case lower

than  $r_c$ . On the basis of this statement it is possible to declare that there was **no dependence proven** between the higher level of noise caused by the Václav Havel Airport Prague and the lower selling price of flats located in areas supposed to be affected by this airport.

## Analysis of houses for sale by HPM

The similar procedure as in the previous subchapter is applied in case of analysing the dependence between the airport noise and the selling price of houses. The standard deviation has to be set for all three zones at first. While for flats the most important variable was the size of the property, in case of the houses it is the status of the house. Therefore the division of houses is based on the status.

House status (1 to 4)	Location		
	ZONE A	ZONE B	ZONE C
1	302.1	307.6	351.5
2	352.2	373.8	325.7
3	336.1	352.9	290.9
4	383.3	316.0	320.5

**Table 9: Standard deviation for each category of houses for sale**

*Source: MS Excel by author*

Because the standard deviation has been already set and it is stated in the Table 9, right above this paragraph, the second step is again to allocate the mean values for selling price and the noise level of every examined zone. Again, this is only for the daytime, because the author was not interested in nighttime as mentioned before.

House status (1 - 4)	House location					
	ZONE A		ZONE B		ZONE C	
	Average price (CZK)	Noise level (dB)	Average price (CZK)	Noise level (dB)	Average price (CZK)	Noise level (dB)
<b>1</b>	8 490 000	68	7 799 000	59	8 500 000	54
<b>2</b>	7 950 000	59	7 197 500	52	8 617 000	52
<b>3</b>	8 410 000	54	9 045 000	56	9 127 000	60
<b>4</b>	12 900 000	58	8 499 000	55	7 968 750	56

**Table 10: Mean values of price and a level of noise within all three zones according to the house status**

*Source: MS Excel by author*

House status (1 - 4)	House location					
	ZONE A		ZONE B		ZONE C	
	$\Delta$ price	$\Delta$ noise level	$\Delta$ price	$\Delta$ noise level	$\Delta$ price	$\Delta$ noise level
<b>1</b>	- 1.032	- 1.230	1.003	-1.012	1.026	1.011
<b>2</b>	1.023	-1.028	1.005	1.077	-1.007	-1.020
<b>3</b>	1.081	1.074	<b>-1.023</b>	<b>1.018</b>	1.053	-1.034
<b>4</b>	<b>-1.060</b>	<b>1.050</b>	<b>-1.024</b>	<b>1.036</b>	<b>-1.027</b>	<b>1.018</b>

**Table 11: Change in price and the level of noise in comparison to the mean values (houses)**

*Source: MS Excel by author*

In the above situated table the difference between the mean values of noise level and the selling price for each category of houses is obvious. Again, only two zones (A and B) are taken into account because the zone C is located outside the examined area that is supposed to be affected by Prague's airport. From the results highlighted in the table, it is obvious that there are only newly built houses affected by the noise in the zone A. In the zone B fully reconstructed and newly built houses are influenced by the higher level of noise. There is no other dependence proven between other categories of houses in any of the zones. To make sure that the results are correct and to make the final decision whether the price is really influenced by an abnormal level of noise in that area the correlation analysis is required. Therefore the next step is the correlation table construction where all the results from the Table 11 should be verified.

House status	Location			
	ZONE A		ZONE B	
	r	$r_c$	r	$r_c$
<b>3</b>	<b>X</b>	<b>X</b>	0.328	0.755
<b>4</b>	0.866	0.996	-0.001	0.996

**Table 12: Coefficient of correlation according to the house status for zone A, B (houses)**

*Source: MS Excel by author*

After the verification of all the results from Table 11, it was finally found out that in the case of houses, there is no significant dependence between the selling price of house and the higher level of noise around the property. By the statistical analysis it has been proven that there is no such dependence because in any of the tested group of houses the value of the correlation coefficient ( $r$ ) did not exceed its critical value ( $r_c$ ). It is the same as in the case of analysis of flats for sale, the hypothesis has been disproved. Therefore the chapter conclusion sounds that

there is **no such dependence** between the lower selling price in the area nearby the Václav Havel Airport Prague and the higher level of noise in these locations.

### 4.3.2. Evaluation of results

The external factors were set and described in the very beginning of the chapter 4.3. Also the graph showing the dependence between the selling price and the distance from the Václav Havel Airport Prague was attached. From this graph it is obvious that there is no dependence between the distance and the selling price. The price is fluctuating in every zone. Therefore the next step was to perform the hedonic pricing method with a clear objective – to find out whether the hypothesis of the Diploma Thesis is correct or not. At first the HPM was applied for flats for sale. Properties were divided into three zones (A, B and C) and also according to the internal attributes which affects the price mostly. In this case it was a flat size (m<sup>2</sup>). The author then performed the analysis and made all the necessary correlation testing. The result is that there was no significant dependence between the lower selling price of flat and the higher noise level in the examined areas. This means that the hypothesis has been disproved **and there is no influence on price by the noise caused by Prague's main airport**. Consequently the similar analysis was applied on the houses for sale. Houses were divided according to the zone (A, B and C) and the internal factor influencing price. In this case it was the house status. Also in this case the hypothesis was not confirmed and rejected. Correlation analysis did not reveal any dependence between the lower selling price of any category of houses and the significantly higher level of noise at the location where the house is situated. Therefore **the negative influence on selling price by noise caused by the Václav Havel Airport Prague is not proven**.

The analysis done by HPM by using correlations did not found any dependence between the dependent and independent variables. It means no



significant influence of lower price of flats and houses for sale by enormous noise caused by the airport has been proven. Therefore there is **no reason for applying the regression analysis.**

#### **4.4. Conclusion**

Hedonic pricing method is a method for valuation of non-market assets. The method is based on the real and actual behaviour of consumers. It uses the data from the real, not the hypothetical market. Model of HPM is based on two initial theories. Lancaster's theory and Rosen's model, which extends the hedonic model by the demand side analysis. It is necessary to find out the hedonic pricing function by regression models and also the demand function of non-market asset, to calculate the implicit prices of such asset. The HPM principle has been used since 20s of the 20<sup>th</sup> century and the massive expansion was during 60s of this century. In the Czech Republic the method still has not been frequently used.

For the purpose of this thesis the HPM was applied in relation to the analysis of noise pollution. It has been proven that the enormous level of noise is a significant disturbing element which influences the quality of life. The main and the largest airport in the Czech Republic – Václav Havel Airport Prague was chosen as the main source of disturbing noise. There are many other potential environmental threats and disturbing elements caused by this airport, but the noise was selected as the most important one. The author is therefore focusing on the impact of the enormous noise caused by the Václav Havel Airport Prague on the locations nearby the airport and he is comparing these areas with localities situated in the different parts of Prague or even outside the capital city, that are supposed not to be influenced by disturbing noise from the airport. In connection with the HPM principle the real estate market was chosen as the most suitable one for performing the analysis. Locations were divided into three zones, where zone A

and B are supposed to be affected by the higher level of noise while zone C should not be affected. Also two types of properties were selected. The first are flats for sale and the second are houses for sale. Only the properties with very similar type and area were used. There are 30 properties in each zone, it means that in total 90 flats and 90 houses for sale were examined. The level of noise was derived from the current noise chart of Prague and from the documents published by Letiště Praha a.s., the airport main operator. Only the daytime data were used because of the objective results. After the data gathering and the transformation process was done, the internal attributes were examined by the author using the correlation analysis. In case of flats the most important internal attribute, influencing the price mostly is a size of flat ( $m^2$ ). In case of houses it is a status of the house, usually newly built houses are being sold for the highest price. When these factors were taken into account the analysis of internal factors and mainly the environmental factor which is in this case the level of noise were examined. The HPM had been applied to find the differences between the mean values and the real values of each property in every zone. After that the correlation analysis was done again, to confirm and prove the results. Because the main hypothesis was not confirmed, it was therefore not relevant to apply the regression analysis, by which a suitable hedonic pricing function or the implicit price of noise can be set. It means that there was no dependence between the higher level of noise caused by the Václav Havel Airport Prague and examined location confirmed. There was no such relation found in case of both types of properties. There are several reasons why the hypothesis was not confirmed. Some of them are related to the limits of HPM, for example complexity of data gathering. Another possible factor that may distort the results is the macroeconomic situation, the impact of economic situation on household's expenditures and priorities. Also the data of noise level in each location can be little bit inexactitude. On the other hand the whole research, on which the thesis is focused, has discovered that the possible lower quality environment caused by the airport noise is not reflected on the selling price of any examined property in the

target area. It means that on the basis of analysis it is possible to mention that there was no people's willingness to pay for a better environmental quality proven. Citizens or potential buyers in these areas do not consider the higher level of noise as a negative factor influencing the selling price of the property.

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## **6. SUPPLEMENTS AND GLOSSARY**

### **LIST OF SUPPLEMENTS**

**Supplement 1:** Parallel runway 24L/06R at Václav Havel Airport Prague

**Supplement 2:** Flats for sale (zone A)

**Supplement 3:** Flats for sale (zone B)

**Supplement 4:** Flats for sale (zone C)

**Supplement 5:** Houses for sale (zone A)

**Supplement 6:** Houses for sale (zone B)

**Supplement 7:** Houses for sale (zone C)

**Supplement 8:** Legend for both flats and houses for sale tables

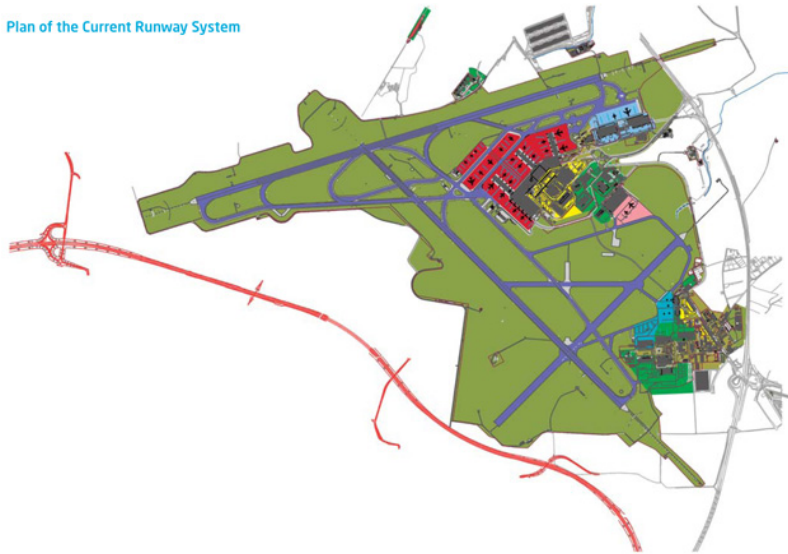
**Supplement 9:** Noise level of specific location nearby the airport (07/2014)

**Supplement 10:** Noise level of specific location nearby the airport (02/2014)

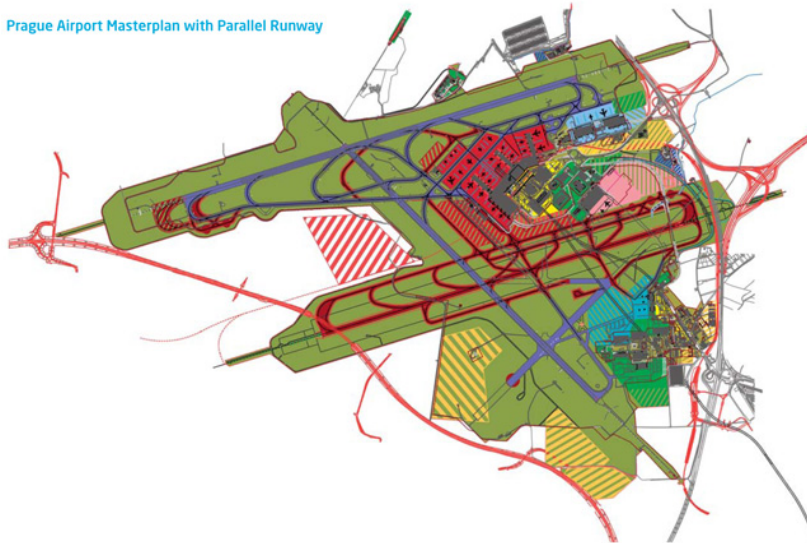
**Supplement 11:** Noise level of specific location explained by graph (07/2014)

**Supplement 12:** Noise level of specific location explained by graph (02/2014)

Plan of the Current Runway System



Prague Airport Masterplan with Parallel Runway



**Supplement 1 : Future plan of the parallel runway 24L/06R at Václav Havel Airport Prague**

Source: Letiště Praha a.s.<sup>[18]</sup>

FLATS FOR SALE													
PRICE	LOCALITY												
	AREA (m <sup>2</sup> )	PRICE PER M <sup>2</sup>	TYPE OF FLAT	FLOOR	RECONSTRUCTION	FURNISHINGS	OWNERSHIP	GARAGE	ELEVATOR	TERRACE/BALCONY	AREA (m <sup>2</sup> )	LOCATION	AD Dist
4750000	86	55 233 3 KB	1	1	4	2	2	0	1	1	150	Přední Kopanina	2
4200000	80	52 500 3 KB	1	1	4	1	2	1	1	1	190	Přední Kopanina	2,5
7530000	91	82 747 3 KB	3	4	4	1	2	0	1	1	136	Praha - Ruzyně	2,2
3650000	76	48 026 3 KB	1	3	3	2	2	0	1	1	5	Praha - Ruzyně	2,3
4350000	97	44 845 3 KB	2	4	4	1	2	0	1	1	13	Praha - Ruzyně	2
6700000	99	67 677 3 KB	2	4	4	2	2	1	1	1	59	Praha - Ruzyně	2,4
2899000	68	42 632 3 KB	3	3	3	1	2	0	0	0	4	Praha - Ruzyně	2,6
6380000	99	64 444 3 KB	3	4	4	1	2	1	1	1	13	Praha - Ruzyně	3
3550000	75	47 333 3 KB	3	3	3	3	2	0	1	1	4	Praha - Ruzyně	2,5
5250000	98	53 571 3 KB	1	4	4	1	2	0	1	1	49	Praha - Ruzyně	2,4
3300000	73	45 205 3 KB	11	1	1	1	2	0	1	1	5	Praha - Ruzyně	2,2
4999900	93	53 762 3 KB	1	4	4	1	2	1	1	1	14	Praha - Ruzyně	3
3700000	90	41 111 3 KB	2	2	3	2	2	0	0	0	0	Praha - Řepy	3,1
3300000	80	41 250 3+1	3	3	2	2	2	0	1	1	5	Praha - Řepy	3
3000000	72	41 667 3+1	4	4	2	1	1	0	1	0	0	Praha - Řepy	3,2
2699000	72	37 486 3+1	4	4	2	1	1	0	1	1	5	Praha - Řepy	3,3
2500000	82	30 488 3+1	2	2	1	1	1	0	1	1	7	Praha - Řepy	3,1
2740000	74	37 027 3+1	3	3	1	1	2	0	1	1	4	Praha - Řepy	3,1
3984000	78	51 077 3 KB	1	4	4	1	2	0	1	1	6	Praha - Řepy	3
2799000	75	37 320 3+1	1	1	2	1	2	0	1	1	6	Praha - Řepy	3,2
3100000	71	43 662 3 KB	4	4	1	1	2	0	1	0	0	Praha - Řepy	3,5
3590000	83	43 253 3 KB	2	4	4	2	2	0	0	0	5	Praha - Řepy	3
3500000	84	41 667 3+1	3	3	3	1	2	1	0	1	4	Praha - Řepy	3,2
3360000	85	39 529 3 KB	5	2	2	2	2	0	1	1	8	Hostivice	2
3260000	80	40 750 3+1	1	2	2	2	2	0	0	0	5	Hostivice	2,2
3790000	90	42 111 3 KB	2	3	3	2	2	0	0	0	9	Hostivice	2,3
3719000	78	47 679 3 KB	2	4	4	1	2	1	1	1	40	Hostivice	2,1
3794000	93	40 796 3 KB	5	4	4	1	2	1	1	1	25	Hostivice	2
3500000	78	44 872 3 KB	2	3	3	2	2	0	0	0	4	Hostivice	2
3800000	80	47 500 3 KB	3	3	3	2	2	0	0	0	69	Hostivice	2,3

### Supplement 2: Flats for sale (zone A)

Source: RE/MAX Czech Republic <sup>[24]</sup>, Sreality <sup>[25]</sup>, MS Excel by author



FLATS FOR SALE															
LOCALITY	Zone B	PRICE	AREA (m <sup>2</sup> )	PRICE PER m <sup>2</sup>	TYPE OF FLAT	FLOOR	RECONSTRUCTION	FURNISHINGS	OWNERSHIP	GARAGE	ELEVATOR	TERRACE/BALCONY	AREA (m <sup>2</sup> )	LOCATION	AD Dist
		2350000	55	42727	2+1	5	2	2	2	0	1	1	4	Ratkovy	9,5
		2490000	54	46111	2+1	3	3	2	2	0	1	1	4	Ratkovy	9
		2899000	66	43924	2+1	1	1	2	2	0	1	1	3	Ratkovy	9,2
		5580000	108	51667	3 KB	3	3	3	2	1	1	1	74	Ratkovy	9,1
		4200000	80	52500	3 KB	3	3	2	2	1	1	1	7	Ratkovy	8,9
		4500000	72	62500	3 KB	6	3	2	2	1	1	0	0	Praha - Suchbátol	7,6
		3390000	67	50597	3 KB	1	3	2	2	0	1	1	20	Praha - Suchbátol	7,5
		4940000	80	61750	3 KB	1	3	1	2	1	1	1	18	Praha - Suchbátol	7,4
		4990000	90	55444	3 KB	1	3	1	2	1	1	1	22	Praha - Suchbátol	7,6
		4450000	96	46354	3 KB	4	3	2	2	1	1	0	0	Praha - Suchbátol	7,5
		4650000	103	45146	3 KB	5	3	2	2	0	0	0	0	Praha - Suchbátol	8
		5600000	83	67470	3 KB	3	4	2	2	0	0	1	32	Praha - Suchbátol	8
		4300000	70	61429	3 KB	6	3	2	2	0	1	0	0	Praha - Suchbátol	7,3
		4600000	89	51685	3 KB	1	4	1	2	0	0	1	199	Horoměřice	4,5
		2000000	81	24691	3 KB	2	3	2	1	1	0	1	24	Horoměřice	4,4
		2990000	63	47460	3+1	2	3	2	2	0	0	0	0	Horoměřice	4,3
		4200000	80	52500	3 KB	1	4	1	2	1	0	1	192	Horoměřice	4,5
		3700000	82	45122	3 KB	2	3	2	2	1	0	1	24	Horoměřice	4,8
		3990000	81	49259	3 KB	2	3	2	2	1	0	1	10	Horoměřice	4,5
		3490000	87	40115	3+1	3	3	2	2	1	0	1	4	Horoměřice	4,3
		5400000	120	45000	3 KB	3	4	1	2	0	0	1	12	Horoměřice	4,2
		4599000	104	44221	3 KB	1	4	1	2	1	0	1	197	Horoměřice	4
		5200000	102	50980	3 KB	3	4	2	2	1	1	1	30	Horoměřice	4,5
		3198000	60	53300	3 KB	1	4	1	2	1	0	1	75	Horoměřice	4,6
		1450000	63	23016	3 KB	3	3	2	1	1	0	1	12	Horoměřice	4,7
		2490000	60	41500	3 KB	2	3	2	1	1	0	1	5	Horoměřice	4,6
		5400000	110	49091	3 KB	3	4	1	2	1	0	1	22	Horoměřice	4,5
		4700000	90	52222	3 KB	1	4	1	2	1	0	1	14	Horoměřice	4,6
		3098000	76	40763	3 KB	3	3	1	2	1	0	1	5	Horoměřice	4,7
		2740000	73	37534	3 KB	3	3	2	2	1	1	1	12	Horoměřice	4,6

### Supplement 3: Flats for sale (zone B)

Source: RE/MAX Czech Republic<sup>[24]</sup>, Sreality<sup>[25]</sup>, MS Excel by author

FLATS FOR SALE															
LOCALITY	Zone C														
	PRICE CZK	AREA (m <sup>2</sup> )	PRICE PER M <sup>2</sup>	TYPE OF FLAT	FLOOR	RECONSTRUCTION	FURNISHINGS	OWNERSHIP	CARAGE	ELEVATOR	TERRACE	BALCONY	AREA (m <sup>2</sup> )	LOCATION	AD DIST
4 670 000	81	57 654	3 K/B	7	4	1	2	2	1	1	1	1	16	Praha - Letňany	17
4 494 000	91	49 385	3 K/B	2	4	1	2	0	0	1	1	1	3	Praha - Letňany	17,5
2 800 000	83	33 735	3 K/B	2	1	1	2	0	0	0	0	1	19	Praha - Letňany	17,5
4 800 000	84	57 143	3 K/B	8	4	4	2	0	1	1	1	1	10	Praha - Letňany	18
4 530 000	85	55 294	3 K/B	4	4	4	2	1	1	1	1	1	17	Praha - Letňany	17
3 885 000	89	43 764	3 K/B	2	4	4	2	0	0	1	1	1	4	Praha - Letňany	17,4
4 390 000	98	44 796	3 K/B	6	4	4	2	1	1	1	1	1	122	Praha - Letňany	17,3
3 668 000	80	45 850	3 K/B	7	4	4	2	1	1	1	1	1	4	Praha - Letňany	17,2
4 799 000	84	57 131	3 K/B	8	4	4	2	0	1	1	1	1	50	Praha - Letňany	17,4
2 999 999	66	45 455	3 K/B	4	4	3	2	0	1	1	1	1	3	Praha - Letňany	17,5
5 500 000	97	56 701	3 K/B	4	4	4	2	1	1	1	1	1	3	Praha - Letňany	17,6
3 689 000	81	45 543	3 K/B	4	4	4	2	0	1	1	1	1	4	Praha - Letňany	18
4 751 000	91	53 209	3 K/B	4	4	4	2	1	1	1	1	1	3	Praha - Letňany	18
2 500 000	68	36 765	3+1	2	4	4	1	0	1	1	1	0	0	Praha - Prosek	16
6 077 000	75	81 027	3 K/B	3	4	4	2	1	1	1	1	1	20	Praha - Prosek	16,2
6 650 000	83	80 120	3 K/B	1	4	4	2	1	1	1	1	1	17	Praha - Prosek	16,3
4 970 000	83	59 880	3 K/B	1	3	3	2	1	1	1	1	1	51	Praha - Prosek	16,4
5 950 000	93	63 978	3 K/B	3	3	3	2	1	0	0	0	0	0	Praha - Prosek	16,5
6 500 000	106	61 321	3 K/B	4	4	4	2	1	1	1	1	1	12	Praha - Prosek	16,7
3 100 000	75	41 333	3+1	7	2	2	2	0	1	1	1	1	7	Praha - Prosek	16,8
3 599 000	71	50 690	3 K/B	9	3	3	2	0	1	1	1	0	0	Praha - Prosek	16,2
5 800 000	110	52 727	3 K/B	4	4	4	2	1	1	1	1	1	24	Praha - Kuratice	18
6 190 000	78	79 359	3 K/B	4	4	4	2	0	1	1	1	1	6	Praha - Kuratice	18,5
4 480 000	81	55 432	3+1	6	4	4	2	1	1	1	1	1	10	Praha - Kuratice	18,2
4 299 999	86	50 000	3 K/B	4	4	4	2	1	1	1	1	1	6	Praha - Kuratice	18,3
3 980 000	72	55 278	3 K/B	2	4	4	2	0	0	0	0	0	0	Praha - Kuratice	18
2 590 000	82	31 585	3+1	5	1	1	1	0	1	1	1	1	4	Praha - Kuratice	18
3 080 000	81	38 148	3+1	8	2	2	1	0	1	1	1	1	4	Praha - Kuratice	18,4
2 900 000	75	38 667	3+1	5	1	1	2	1	1	1	1	1	7	Praha - Kuratice	18,3
2 490 000	52	47 885	3 K/B	6	2	2	1	0	1	1	1	0	0	Praha - Kuratice	18,2

Supplement 4: Flats for sale (zone C)

Source: RE/MAX Czech Republic<sup>[24]</sup>, Sreality<sup>[25]</sup>, MS Excel by author

HOUSES FOR SALE													
LOCALITY	Zone A												
PRICE	AREA (m <sup>2</sup> )	PRICE PER m <sup>2</sup>	NO. OF ROOMS	FLOOR	RECONSTRUCTION	TYPE OF WALL	GARAGE	GARDEN	AREA (m <sup>2</sup> )	LOCATION	AD DISK		
13 500 000	300	45 000	8	2	1	1	0	1	2400	Přední Kopanina	2,2		
12 900 000	336	38 393	7	4	4	1	1	1	385	Přední Kopanina	2,4		
8 400 000	270	31 111	7	2	3	1	1	0	417	Přední Kopanina	2		
15 970 000	264	60 492	7	2	4	1	1	1	1097	Přední Kopanina	2,3		
12 499 000	204	61 270	5	2	1	1	0	1	910	Praha - Ruzyně	2		
9 849 000	254	38 776	6	2	2	1	1	1	305	Praha - Ruzyně	2,6		
10 300 000	220	46 818	9	2	2	1	1	1	196	Praha - Ruzyně	2,5		
8 490 000	250	33 960	9	2	1	1	1	1	310	Praha - Ruzyně	3,2		
11 200 000	258	43 411	7	3	2	1	1	1	449	Praha - Ruzyně	2		
14 855 000	200	74 275	6	1	4	1	1	1	960	Praha - Ruzyně	3		
16 090 000	275	58 509	7	3	3	1	1	1	570	Praha - Ruzyně	3		
11 699 000	210	55 710	6	3	3	1	1	1	399	Praha - Ruzyně	2,8		
10 850 000	204	53 186	7	2	1	1	1	1	284	Praha - Ruzyně	2,4		
7 700 000	220	35 000	6	3	2	1	1	1	73	Praha - Řepy	3,3		
7 900 000	266	29 699	6	4	2	1	1	1	124	Praha - Řepy	3		
13 000 000	296	43 919	6	3	2	1	1	1	419	Praha - Řepy	3,3		
12 900 000	215	60 000	8	3	4	1	1	1	85	Praha - Řepy	3,1		
6 800 000	261	26 054	6	3	2	1	1	1	82	Praha - Řepy	3,1		
9 270 000	200	46 350	7	3	2	1	1	1	176	Praha - Řepy	3		
12 200 000	230	53 043	7	3	1	1	1	1	375	Praha - Řepy	3		
6 890 000	230	29 957	6	2	2	1	1	1	469	Hostivice	3,7		
5 490 000	274	20 036	6	3	1	1	1	1	226	Hostivice	3		
7 700 000	250	30 800	6	3	3	1	1	1	225	Hostivice	2,8		
8 500 000	300	28 333	6	3	2	1	1	1	529	Hostivice	2		
7 250 000	222	32 658	6	2	3	1	1	1	517	Hostivice	2,3		
8 900 000	200	44 500	5	2	3	1	1	1	822	Hostivice	2,2		
9 900 000	219	45 205	6	2	3	1	1	1	687	Hostivice	2,1		
9 950 000	205	48 537	5	2	3	1	1	1	701	Hostivice	2		
10 600 000	235	45 106	6	2	4	1	1	1	900	Hostivice	2		
7 200 000	200	36 000	5	2	3	1	1	1	562	Hostivice	2,3		

### Supplement 5: Houses for sale (zone A)

Source: RE/MAX Czech Republic<sup>[24]</sup>, Sreality<sup>[25]</sup>, MS Excel by author

HOUSES FOR SALE													
LOCALITY	Zone B												
PRICE	AREA (m2)	PRICE PER m2	NUMBER OF ROOF	FLOOR	RECONSTRUCTION	TYPE OF WALL	GARAGE	GARDEN	AREA (m2)	LOCATION	AD Dist		
7 495 000	237	31 624	8	2	2	1	1	1	217	Rožtoky	10		
11 790 000	210	56 143	7	2	3	1	1	1	546	Rožtoky	10,2		
6 900 000	200	34 500	5	1	2	1	0	1	806	Rožtoky	9		
10 950 000	225	48 667	6	2	2	3	0	1	398	Rožtoky	9		
9 325 000	260	35 865	6	2	2	1	1	1	297	Rožtoky	8,5		
9 290 000	259	35 869	6	3	1	1	1	1	784	Rožtoky	7,5		
9 990 000	232	43 060	7	2	3	1	1	1	616	Rožtoky	7,6		
7 898 000	221	35 738	6	2	1	1	1	1	759	Rožtoky	7,4		
7 190 000	255	28 196	6	2	1	1	1	1	615	Praha - Suchbátol	7,6		
9 800 000	250	39 200	8	3	2	1	1	1	917	Praha - Suchbátol	8		
8 500 000	250	34 000	6	2	1	1	1	1	461	Praha - Suchbátol	8		
11 900 000	250	47 600	6	4	2	1	1	1	404	Praha - Suchbátol	7,5		
10 000 000	200	50 000	7	2	1	1	1	1	945	Praha - Suchbátol	7,3		
17 700 000	238	74 370	5	2	4	1	1	1	466	Praha - Suchbátol	4,3		
7 700 000	200	38 500	7	2	1	1	0	1	320	Praha - Suchbátol	4,4		
15 900 000	300	53 000	8	4	3	1	1	1	418	Praha - Suchbátol	4,3		
7 500 000	220	34 091	5	2	3	1	1	1	326	Horoměřice	4		
7 650 000	290	26 379	7	3	3	1	1	1	487	Horoměřice	4,8		
5 700 000	216	26 389	7	2	2	1	0	1	146	Horoměřice	4,5		
8 590 000	279	30 789	6	2	3	1	1	1	454	Horoměřice	4,3		
7 980 000	300	26 600	7	2	2	1	1	1	500	Horoměřice	4,2		
12 500 000	270	46 296	8	2	3	1	1	1	646	Horoměřice	4		
7 900 000	200	39 500	5	2	4	1	1	1	433	Horoměřice	4,4		
12 500 000	290	43 103	8	2	3	1	1	1	480	Horoměřice	4,6		
5 999 000	274	21 894	5	2	2	1	1	1	375	Horoměřice	4,7		
5 980 000	200	29 900	7	3	3	1	1	1	255	Horoměřice	4,6		
8 500 000	286	29 720	6	2	4	1	1	1	342	Horoměřice	4,5		
8 499 000	260	32 688	5	2	4	1	1	1	179	Horoměřice	4,6		
9 750 000	300	32 500	6	2	3	1	1	1	287	Horoměřice	4,8		
9 500 000	300	31 667	7	2	3	1	1	1	703	Horoměřice	4,7		

### Supplement 6: Houses for sale (zone B)

Source: RE/MAX Czech Republic <sup>[24]</sup>, Sreality <sup>[25]</sup>, MS Excel by author

HOUSES FOR SALE													
LOCALITY	Zone C	PRICE	AREA (m2)	PRICE PER m2	NUMBER OF ROOM	FLOOR	RECONSTRUCTION	TYPE OF WALL	GARAGE	GARDEN	AREA (m2)	LOCATION	AD Dist
8 690 000	223	38 969	223	38 969	5	2	4	1	1	1	146	Praha - Letňany	18
9 800 000	300	32 667	300	32 667	8	2	1	1	1	1	749	Praha - Letňany	17
7 247 500	220	32 943	220	32 943	6	2	4	1	1	1	268	Praha - Letňany	17,5
8 190 000	210	39 000	210	39 000	6	2	2	1	1	1	663	Praha - Letňany	18
10 900 000	300	36 333	300	36 333	6	2	3	1	1	1	472	Praha - Letňany	17
9 100 000	270	33 704	270	33 704	7	3	3	1	1	1	738	Praha - Letňany	17,5
8 300 000	228	36 404	228	36 404	6	2	3	1	1	1	517	Praha - Letňany	17,3
7 800 000	250	31 200	250	31 200	5	2	3	1	1	1	286	Praha - Letňany	16,9
8 900 000	275	32 364	275	32 364	6	2	3	1	1	1	480	Praha - Letňany	17,2
7 870 000	215	36 605	215	36 605	7	2	1	1	0	1	302	Praha - Prosek	17,5
8 890 000	230	38 652	230	38 652	8	3	2	1	1	1	147	Praha - Prosek	17,6
11 200 000	240	46 667	240	46 667	7	2	3	1	0	1	204	Praha - Prosek	18,2
9 200 000	230	40 000	230	40 000	8	3	2	1	1	1	140	Praha - Prosek	17,9
14 300 000	250	57 200	250	57 200	6	2	4	1	1	1	323	Praha - Kunratic	16
12 900 000	300	43 000	300	43 000	9	2	3	1	1	1	693	Praha - Kunratic	16,2
14 390 000	250	57 560	250	57 560	6	2	4	1	1	1	259	Praha - Kunratic	16,3
11 900 000	300	39 667	300	39 667	7	2	3	1	1	1	840	Praha - Kunratic	16,5
8 500 000	220	38 636	220	38 636	5	2	1	1	1	1	743	Praha - Kunratic	16,7
9 700 000	218	44 495	218	44 495	8	3	2	1	1	1	242	Praha - Kunratic	16
8 345 000	200	41 725	200	41 725	5	2	2	1	1	1	156	Praha - Kunratic	16,8
11 500 000	250	46 000	250	46 000	8	2	3	1	1	1	650	Praha - Kunratic	16,3
8 200 000	207	39 614	207	39 614	7	2	2	1	1	1	653	Praha - Kunratic	17,8
8 990 000	290	31 000	290	31 000	6	2	4	3	1	1	425	Praha - Kunratic	18,4
6 990 000	200	34 950	200	34 950	4	1	2	1	1	1	350	Praha - Kunratic	18,2
14 990 000	268	55 933	268	55 933	7	2	4	1	1	1	329	Praha - Kunratic	18,3
13 900 000	250	55 600	250	55 600	6	2	3	1	1	1	700	Praha - Kunratic	18
6 100 000	200	30 500	200	30 500	5	2	4	1	1	1	130	Praha - Kunratic	18
9 900 000	282	35 106	282	35 106	7	3	2	1	0	1	69	Praha - Kunratic	18,5
8 950 000	274	32 664	274	32 664	8	2	2	1	1	1	214	Praha - Kunratic	18,4
9 154 000	217	42 184	217	42 184	5	2	3	1	1	1	142	Praha - Kunratic	18,6

**Supplement 7: Houses for sale (zone C)**

Source: RE/MAX Czech Republic <sup>[24]</sup>, Sreality <sup>[25]</sup>, MS Excel by author

<b>LEGEND:</b>				
RECONSTRUCTION	1 = NO RECON	2 = PARTIAL	3 = TOTAL RECON	4 = NEW
TYPE OF WALL	1 = BRICK	2 = PANEL	3 = OTHER	
OWNERSHIP	1 = COOPERATIVE	2 = PERSONAL		
FURNISHINGS	1 = NO	2 = PARTIAL	3 = FULL	

**Supplement 8: Legend for both flats and houses for sale tables**

*Source: MS Excel by author*

Location	Day			Night		
	Aircraft LAeq	Community LAeq	Total LAeq	Aircraft LAeq	Community LAeq	Total LAeq
Jeneč	55,8	68,6	68,8	52,7	52,8	55,7
Červený Újezd	50,4	75,5	75,5	47,1	49,3	51,3
Unhošť	51,8	51,4	54,6	49,2	42,0	50,0
Pavlov	51,9	53,7	55,9	48,9	46,5	50,9
Hostivice	40,0	53,8	54,0	36,9	47,0	47,4
Dobrovíz	51,8	53,6	55,8	46,0	47,0	49,5
Kněžves	52,9	54,2	56,6	49,3	50,3	52,9
Horoměřice střed	56,9	53,9	58,7	51,9	52,4	55,2
Přední Kopanina	57,1	57,6	60,4	49,9	47,9	52,0
Horoměřice JV	52,0	53,3	55,7	46,9	42,4	48,2
Řepy	42,8	58,2	58,3	26,3	50,9	50,9
Bílá Hora	46,2	52,3	53,3	31,1	44,6	44,8
Suchdol	55,0	50,6	56,4	50,0	41,7	50,6

**Supplement 9: The level of noise in a specific location nearby the airport (July 2014)**

Source: Noise Level Measurements by Letiště Praha a.s. <sup>[12]</sup>

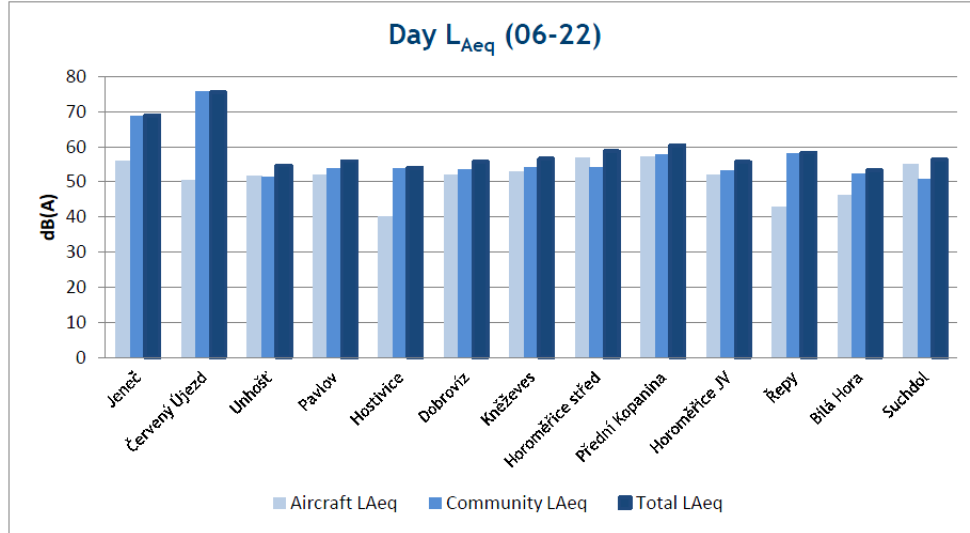
Location	Day			Night		
	Aircraft LAeq	Community LAeq	Total LAeq	Aircraft LAeq	Community LAeq	Total LAeq
Jeneč	56,1	53,1	57,9	49,0	47,2	51,2
Červený Újezd	50,3	54,2	55,7	43,3	47,0	48,5
Unhošť	51,3	49,4	53,5	44,6	40,4	46,0
Pavlov	52,5	52,1	55,3	45,3	46,9	49,2
Hostivice	41,1	50,6	51,0	33,6	43,1	43,6
Dobrovíz	52,4	52,0	55,2	43,8	45,3	47,6
Kněžves	55,1	55,5	58,3	46,2	50,0	51,5
Horoměřice střed	56,1	52,6	57,7	48,0	45,6	50,0
Přední Kopanina	51,8	54,6	56,4	42,4	48,0	49,1
Horoměřice JV	49,1	53,5	54,8	41,5	41,7	44,6
Řepy	43,7	57,8	58,0	24,1	45,8	45,8
Bílá Hora	44,6	51,9	52,6	33,6	43,7	44,1
Suchdol	54,1	50,2	55,6	46,3	39,5	47,1

**Supplement 10: The level of noise in a specific location nearby the airport (February 2014)**

Source: Noise Level Measurements by Letiště Praha a.s. <sup>[12]</sup>

Prague Airport  
Monthly LAeq,T - day, night

Date: From 01.07.2014 0:00:00 to 31.07.2014 23:59:59



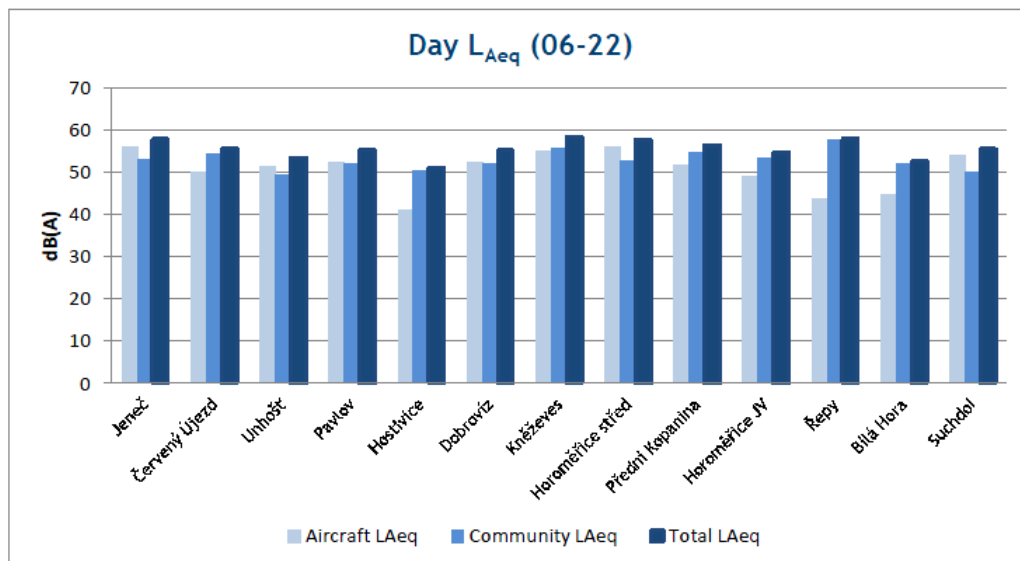
Supplement 11: The level of noise in a specific location nearby the airport explained by graph (July 2014)

Source: Noise Level Measurements by Letiště Praha a.s. [12]



Prague Airport  
 Monthly LAeq,T - day

Date: From 01.02.2014 0:00:00 to 28.02.2014 23:59:59



Supplement 12: The level of noise in a specific location nearby the airport explained by graph (February 2014)

Source: Noise Level Measurements by Letiště Praha a.s. [12]

## **GLOSSARY**

**AD** – Aerodrome

**AIP** – Aeronautical Information Publication

**AIS** – Aeronautical Information Service

**ATC** – Air Traffic Control

**CZK** – Czech crown

**dB** – Decibel

**ECB** – European Central Bank

**EU** – European Union

**HPM** – Hedonic Pricing Method

**IATA** – International Air Transport Association

**ICAO** – International Civil Aviation Organization

**Ltd.** – Limited company

**MTOW** – Maximum Take-off Weight

**RWY** – Runway

**WTA** – Willingness to accept

**WTP** – Willingness to pay