

**Czech University of Life Sciences Prague**

**Faculty of Economics and Management**

**Department of Information Technologies**



**Bachelor Thesis**

**Open data and mobile application for civil aviation**

**Kristýna Marie-Thérese Žárová**

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# CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

## BACHELOR THESIS ASSIGNMENT

Kristýna Marie-Thérese Žárová

Business Administration

Thesis title

**Open data and mobile application for civil aviation**

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### Objectives of thesis

The main objective is to propose a mobile application for civil aviation based on open data in the Czech Republic.

Partial goals of the thesis are such as:

- to analyse the current situation of open data in the Czech Republic with a special focus on civil aviation domain;
- to propose and an application for civil aviation based on open data;
- to create a feasibility study of the proposed application.

### Methodology

Methodology of the thesis is based on the study of resources, field study and practical part, where the availability and usability of open data for civil aviation in the Czech Republic will be investigated. Evaluation of the proposed application will be made with SWOT analysis and relevant financial analysis methods. As a result of the investigation a sample open data application will be proposed and evaluated.

**The proposed extent of the thesis**

30 – 40 pages

**Keywords**

open data, publication, civil aviation, safety, Airworthiness Directive, Safety Information Bulletin, mobile application

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**Recommended information sources**

BOČEK, Jan, Jakub MRÁČEK a Jindřich MYNARZ. Otevřená data: příležitost pro Českou republiku. Praha: Nadace Open Society Fund, 2012. ISBN 978-80-87725-02-3.

European Aviation Safety Agency, [online], available at: <https://www.easa.europa.eu>

GURIN, Joel. Open data now: the secret to hot startups, smart investing, savvy marketing, and fast innovation, 2014. ISBN 0071829776

PIRNEROVÁ, Helena a Michal TOŠOVSKÝ. Příloha týdeníku Ekonom. Otevřená data, jak Česko umí využít potenciál, který má internet. Praha: Economia, a.s., 2015

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## **Declaration**

I declare that I have worked on my bachelor thesis titled " Open data and mobile application for civil aviation" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 15. 3. 2017

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I would like to thank Ing. Miloš Ulman, Ph.D. , Doc. Ing. Marcela Žárová, CSc., and Ing. Michal Klas for their advice and support during my work on this thesis.

# Otevřená data a mobilní aplikace pro civilní letectví

## Souhrn

Hlavním cílem této bakalářské práce je navržení a vývoj mobilní aplikace. Tato aplikace by měla pracovat s otevřenými daty, které jsou dostupné v České republice, a být ku prospěchu účastníkům civilního letectví.

První část této práce je zaměřena na samotné popsání otevřených dat a prozkoumání současné situace v České republice z hlediska otevřených dat. Tuto část následuje vlastní popsání navržené aplikace, strategie vstupu na trh, která umožní přípravu na úspěšné uvedení na trh, a nakonec odhad nákladů a výnosů. Samotný plán navržení a uvedení aplikace na trh bude ohodnocen SWOT analýzou, dobou návratnosti, čistou současnou hodnotou a nakonec vnitřní mírou návratnosti.

Závěrem bakalářské práce je, že navržení aplikace pro civilní letectví, která pracuje s otevřenými daty, je možné.

**Klíčová slova:** Otevřená data, civilní letectví, EASA, AD deklaráce, SIB deklaráce, navržení aplikace

# Open data and mobile application for civil aviation

## **Summary**

The main goal of the bachelor thesis is to propose and develop a mobile application. This application should work with open data available in the Czech Republic and be beneficial for civil aviation.

The first part of thesis is focused on describing of open data and investigation of current situation in the Czech Republic. This part is followed by description of the proposed application, market entry strategy that will allow successful entrance of the application to the market, and estimation of costs and revenues. The project of developing the application is then evaluated by SWOT analysis, payback period, net present value, and internal rate of return.

The conclusion of this thesis is that an open data application for civil aviation is possible to be developed.

**Keywords:** Open data, civil aviation, EASA, AD declaration, SIB declaration, development of application

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# 1 Introduction

As of the year 2013, 90 per cent of all existing data was generated and collected during the last two years<sup>1</sup>. Recently, we became an information society that is living in an information age, in which data and people have become the main infrastructure of the world. Every individual works with some form of data on a daily basis, either actively or passively producing data. Examples of this include using mobile applications for weather broadcast, for public transportation, and even publishing personal information on social media through posts or pictures. We are aware of the huge amounts of data surrounding us, but how can they be utilized without breaking any rules? When working with data that is not one's own, both data providers and terms of use often present limitations and boundaries. Generally, data is shared, but restricted to services and that is the reason why people are becoming more interested in the concept of open data. The goal of open data is to be freely used, modified, and shared by anyone for any purpose and not to be controlled by whoever published them. It is said that the term, *open data*, is the opportunity of this century.

The one of the main reasons for making data, “open,” is to support democracy by introducing a transparent government, for example, we can prevent the corruption or misuse of money. By making data accessible to the public, we can expect people to start a new business by adding a value to the data and making a valuable application. There are many reasons for being interested in open data. For instance, a student uses data for research, a politician needs it to support his decision, or a firm increases its profit by getting more information about its customers.

This thesis will be especially focused on open data in civil aviation, which entails flights and aircrafts for personal or business use, as well as international and national airports. Open data in this section can serve several purposes, such as hobbies, safety issues, or financial enhancement of airlines or airports. This work will mainly cover the question of safety in civil aviation. Accidents of commercial flights are always very well “known,” due to the high number of victims possibly involved. The majority is aware of the disappearance of Malaysia Airlines MH370 in the year 2014. In March 2016, a

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<sup>1</sup> <https://www-01.ibm.com/software/data/bigdata/what-is-big-data.html>

passenger jet from the United Arab Emirates crashed during a landing attempt. The public is typically well informed about these types of air disasters because they are covered heavily in the news, but what about the small, private air crashes? For example, in the Czech Republic, there were 17 air crashes or incidents, which the ÚZPLN (Ústav pro odborné zjišťování příčin leteckých nehod - Air Accidents Investigation Institute of the Czech Republic) investigated during the year 2015. There are many reasons as to why these accidents occur and one of them is, for example, technical failure. The question is whether or not it is possible to prevent related situations and whether open data could be of any help in doing so.

From above mentioned reasons, the thesis is focused in detail on developing open data application for usage in civil aviation. This development of the application is the main goal of the bachelor thesis. At the very beginning objectives and methodology will be defined. After that, the theoretical background will be provided including topics of open data and description of civil aviation. In this chapter the topics open data and civil aviation are described. Based on this is following a business plan for a developing of application for civil aviation. The main topics are the description of the application itself, the market entry strategy, and estimation of expenditures and revenues. This business plan will be analysed by internal and external analysis, payback period, net present value, and internal rate of return. The results of the mentioned chapters above are summarized in a conclusion.

## **2 Objectives and Methodology**

### **2.1 Objectives**

The main aim of this thesis is to propose and develop an open data mobile application.

The thesis investigates the availability and usage of open data in the Czech Republic with a focus on civil aviation. Firstly, the open data will be defined together with discussion of threats and opportunities and the future benefits for the population. In the second step, the current situation of open data in the Czech Republic will be described and the current state of the art of open data application in civil aviation will be evaluated.

The research will be followed by the proposal of mobile application for use in civil aviation. Strategy for market entrance and appropriate evaluation will be described.

### **2.2 Methodology**

The methodology of the thesis is based on the study of resources. The field study provides the necessary information to evaluate the current situation of open data in the Czech Republic, as well as open data in civil aviation in general, and practically speaking, where the availability and usability of open data for civil aviation in the Czech Republic will be investigated. Evaluation of the proposed application will be made with SWOT analysis and relevant financial analysis methods. As a result of the investigation a sample open data application will be proposed and evaluated.

### 3 Literature Review

This literature review shows that there is a substantial amount of resources, which deal with open data in general or so called open government data. As it is a relatively new thing, open data is often associated with the concept of transparent government. To support democracy and to have well-functioning democracy is necessary to keep the citizens informed about the government activities without any hiding and that is why it is important to open up data.

It was found that there is a gap in resources, when we are talking about open data in civil aviation. There is no relevant publication, which would inquire into this field.

#### 3.1 Definition and characteristics of open data

To fully understand the concept of open data, the definition must first be looked at. Many different sources have been used to define the term *open data*. According to Open Knowledge Foundation the definition is as follows: “Open knowledge’ is any content, information or data that people are free to use, re-use and redistribute — without any legal, technological or social restriction.”<sup>2</sup> Open Knowledge Foundation published a guide, the Open Data Handbook, which deals with the legal, social, and technical aspects of open data. The definition according to this handbook is: “Open data is data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and share alike.”<sup>3</sup> Its webpages refers to Open Definition, where a detailed and precise meaning of “open” can be found. The summary is: “Knowledge is open if anyone is free to access, use, modify, and share it - subject, at most, to measures that preserve provenance and openness.”<sup>4</sup> The international expert on open data, Joel Gurin, describes the concept of *open data* as following: “It is public data, from government or other sources, that’s available for anyone to access for personal or business use.”<sup>5</sup>

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<sup>2</sup> Open Knowledge Foundation (2016)

<sup>3</sup> Open Data Handbook (2016)

<sup>4</sup> Open Definition (2016)

<sup>5</sup> Joel Gurin (2014, p.2)

### 3.1.1 Publishing

One very important part of the publication of open data is the format in which they are published. A common mistake is to offer data in files that are not machine readable, for example, scans in PDF (Portable Document Format), since this is inconsistent with part of the definition, which says: “The work must be provided in a form readily processable by a computer and where the individual elements of the work can be easily accessed and modified.”<sup>6</sup> The reason is to make the data easily reusable for others. The best examples of machine-readable formats are CSV (Comma-Separated Values), XLS (Excel Spreadsheet), or XML (Extensible Markup Language).

### 3.1.2 Summary

All the definitions contain the same major idea with little to no variation. When providing data, it is important to make it technically and legally open. Technically open means that the data should be in machine-readable format, provided as a set, if possible for free or for no more than the reproduction cost is. Legally open represents mostly the terms of use, which should allow to use, re-use, redistribute or combine the data to everybody, who intend to work with it.

## 3.2 The opportunities and threats of open data

Open data offers many opportunities and promises as well as threats and risks. The aim of this subchapter is to discuss them and point out the most important ones.

The biggest promise from open data that is publicly discussed, and can be probably labelled as the goal of open data, is the transparency of governments. Data sets on performance and financial transaction being released and being available can lead to growth of government transparency. It is very promising destiny of open data. This transparency is associated with an increase in trust in government. Building the trust and a good reputation can be based on better information that is released by public sector to citizens. The availability of datasets itself does not make the data valuable. A wide range of data is being released every day. Open data itself does not have a value for public. Open data becomes valuable for public only when it is processed. Mainly experts are processing

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<sup>6</sup> Open Definition (2016)

open data for developing an application, because it requires certain level of skills. Only those developed open data applications could bring any profit to the public. Examples of such applications could be: map of criminality, timetable of public transportation, or generating of flood alerts. Releasing of data sets can encourage entrepreneurs or small businesses to develop new applications or to develop new product and services based on information acquired by an application that is processing and working with open data. A result of those innovating and developing actions can support economic growth of certain country. All the opportunities mentioned above can be summarized in those 4 points:

- Transparent government
- A growth of trust in government
- Adding value to data
- Economic growth

With all the benefits that open data brings, come also risks. One of the mostly discussed threats is publishing personal data by accident. In today's age of computers it is a very sensitive topic and public requires a better security, when it comes to personal data. One thing is when someone shares every day life details online through social media or when insurance company has a leak of information that leads to privacy infringement. Probably the worse case scenario of such a leak is stealing someone's identity. A company can face a very similar threat, when its trade secret is revealed. A publication of classified information can arise from releasing other data sets that can be combined, which results in unintentionally exposure of the secret. There is always a risk that data would be wrongly interpreted. It can be done unmeant or in purpose to harm someone or gain competitive advantages. The guardian reported a case of concealing information, because a city has mapped a criminality and parts of the city of high criminality had problems with renting or selling the houses: "A survey by Direct Line Insurance in the same year found that 11% of respondents claim to have seen but not reported an incident because they feared it would make it more difficult to rent or sell their house."<sup>7</sup> Any publishing of data should not be hasty inasmuch as contained information could be misused and cause damages. The threats

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<sup>7</sup> Hand (2012)

that were discussed in this paragraph are summarized in the following 4 points:

- Publication of personal data
- Publication of trade secret
- Misinterpretation
- Concealment of information

### **3.3 Situation in the Czech Republic**

In September 2011, the Czech Republic joined the Open Government Partnership (OGP). “The Open Government Partnership was launched in 2011 to provide an international platform for domestic reformers committed to making their governments more open, accountable, and responsive to citizens.”<sup>8</sup> OGP is an initiative to support openness and transparency of government, which includes the fight against corruption. Nowadays, the Czech Republic is fulfilling the action plan for the years 2014 to 2016 (The Second Action Plan), which consist of:

1. Adoption of the new Act on Civil Servants ensuring depoliticisation, professionalisation and stabilisation of public administration and its implementation into practice
2. Streamlining the system of free access to information
3. Improving access to data and information<sup>9</sup>

The First Action Plan was not fulfilled and that is why the second one took over the commitments.

In the Global Open Data Index, which is run by Open Knowledge, the Czech Republic was listed as number 21 out of 122 in the year 2015. While this appears to be a good score, there is still a lot to improve, as most data is not available or remain in inadequate formats. The evaluated categories are: national statistics, government budget, legislation, procurement tenders, election results, national map, weather forecast, pollutant emissions, company register, location datasets, water quality, land ownership, and government spending. The least open category according to this source is government spending.

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<sup>8</sup> Open Government Partnership (2013)

<sup>9</sup> Open Government Partnership (2014)



One of the main players in informing the public and supporting the opening of data is Fund Otakara Motejla. “The objective of the fund is to create open and effective public administration, cooperating with an active civil society. The introduction of open data is going to create transparent government and allow its citizens to access information about its activities and expenditures.” (Own translation)<sup>10</sup>

### 3.3.1 Civil Aviation in the Czech Republic

The Civil Aviation Authority of the Czech Republic (CAA-CZ; Úřad pro civilní letectví České republiky) supervises civil aviation activities in the Czech Republic, certifies aircrafts, technical equipment, and licenses pilots. CAA is appointed by the state in accordance with the Chicago Convention on International Civil Aviation (ICAO) and it is subordinated to the Ministry of Transport in the Czech Republic.

#### 3.3.1.1 The International Civil Aviation Organization

The International Civil Aviation Organization (ICAO) is an agency of the United Nations, which established the Safety Standards and Recommended Practices that are binding for the members. ICAO’s policies support a safe, efficient, secure, economically sustainable, and environmentally responsible civil aviation sector.

#### 3.3.1.2 The European Aviation Safety Agency

The European Aviation Safety Agency (EASA) is an agency of the European Union, which has regulatory and executive power in the member states, as well as in Switzerland, Norway, Iceland, and Liechtenstein. The tasks of the EASA as given on its web pages are:

- Draft implementing rules in all fields pertinent to the EASA mission
- Certify & approve products and organisations, in fields where EASA has exclusive competence (e.g. airworthiness)
- Provide oversight and support to Member States in fields where EASA has shared competence (e.g. Air Operations , Air Traffic Management)
- Promote the use of European and worldwide standards

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<sup>10</sup> Robert Basch (2015)

- Cooperate with international actors in order to achieve the highest safety level for EU citizens globally (e.g. EU safety list, Third Country Operators authorisations)<sup>11</sup>

As this work considers the improvement in the safety of civil aviation in the Czech Republic due to the introduction of open data, it will focus on the EASA and two of its major declarations. Specifically, an Airworthiness Directive (AD) and a Safety Information Bulletin (SIB) will be looked at. An AD is a notification to owners about a certain safety deficiency of a certified aircraft or its part (engine, propeller, radio, etc.). It is prohibited to operate any aircraft to which an AD applies. A SIB only serves as a source of information to the owner of certified aircraft and does not contain any mandatory instructions.

### **3.4 Open data in civil aviation**

In general there is a very little to find about this topic. For example, on the web pages of United Kingdom, Opening up government, is exactly eight available datasets published by the Civil Aviation Authority. These datasets are related to airlines, airports, punctuality statistics, and passenger experience. Only three of them are available in the CSV format, the rest is remaining in the PDF.

The national catalogue of open data of the Czech Republic does not contain any data sets related to the concept of civil aviation.

#### **3.4.1 The potential**

The potential usage of open data in the civil aviation can be really great. For example, by collecting and publishing data (of course not every information can get public, since some pieces of information need to be kept in secret due to safety issues, for instance passenger evidence) can be reached financial enhancement of airlines and airports as well as it can let to creation of new mobile applications, which would help passengers to have better traveling conditions. An application focusing on technical facilities and equipment of small aircrafts could help private operators to take better care of their aircrafts and that would let to improvement of safety. Hopefully the number of accidents of small aircrafts

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<sup>11</sup> The European Aviation Safety Agency (2016)

would decrease. It is a small number of accidents but there is no doubt about developing such an application, when it is question of saving lives.

The two declarations, AD and SIB, of the EASA will be discussed to link this topic with the improvement in the safety of civil aviation.

If the content of those two types of documents was published in the proper way, by which is meant in machine-readable formats, would it help to make applications, which would help to prevent some accidents? As the aim of the thesis is to find out whether or not open data can be in any use of improving safety of private flights it will be focused on private operators and aeroclubs of the Czech Republic.

## **4 Practical Part**

The practical part is focused on developing of mobile application, that will be used for better orientation of the two EASA declarations, AD and SIB, for members of aeroclubs and private operators in the Czech Republic. This application will have a very specific function and it will be useful only for the operators of aircrafts. This fact defines the target group, which unfortunately makes a small number of potential customers. Therefore it is essential to carry out a good quality market entry strategy to generate the best response possible from the target market. The success of the project is also determined by the costs and obtained revenues.

This chapter will have following structure. Firstly the function of the application itself will be described for better understanding of the concept. Then it will be focused on the market. The target group will be specified and the market entry strategy described. The expenditure estimation will be provided with description of specific expenses as well as estimation of revenues.

### **4.1 Function of the mobile application**

Both declarations, AD and SIB, are published on the official web pages of EASA in PDF documents. The list also includes declarations for airplanes, helicopters, and its parts mainly used in commercial aviation. This fact might bring difficulties for a private operator to follow the new declarations. The main purpose of the application is to inform the user about the new AD and SIB declarations related to his or her aircraft, its parts, and its equipment. The aim is to avoid a situation, when some declaration is missed to applied and in the worse scenario to lead to fatal consequences.

In application, a user will have a personal account, where he/she will register his/her aircraft. It will be possible to insert every part with its serial number. This possibility is an important feature of the application, because some AD or SIB documents are issued for specific part of an aircraft with a specific serial number. The function in general could be described as a personalized search machine that generates only the declarations related to the user's aircraft.

## 4.2 Specification of the target group

The main character of the target group is an operation of aircraft(s), which could be more precisely characterized by division into two groups of private operators and aeroclubs. The target group includes female and male gender. The range of age of the target group is approximately 18-70 years. The minimum of purchasing power of the target group is defined and directly connected with their interest in flying. It is focused only on the market in the Czech Republic.

In the table below, there is a review of operators, pilots and aircrafts in the Czech Republic. The listed operators are the potential users of the mobile application; it makes about 1000 of them.

Operators – legal entity	278
Operators – natural person	750
Pilots	7,620
Aircrafts	2,800

**Table 1: potential users of mobile application AD/SIB generator in the Czech Republic, source: aircraft register of the Czech Republic**

## 4.3 Market entry strategy

A model of „4 P’s“ will be used for description of marketing mix, the way the new application will be taken to market. It defines the marketing options in terms of price, product, promotion, and place. All four parameters are discussed in the following subheads.

### 4.3.1 Price

It is essential to choose the right price for a product. The price has to cover the costs and bring revenues. Moreover, the application has to provide a good service for its price to the user. Different approaches with different level of pricing have to be considered to fulfill these requirements. Therefore three different variations of pricing will be proposed. Each proposal will be evaluated in terms of pros and cons and the best one will be chosen to implement.

<b>Free app with advertising</b>	<b>Try app for free - unlock</b>	<b>Try app for free – Annual charge</b>
+ Download without any restrictions + Potentially more customers + Target group advertising	+ 1 <sup>st</sup> download without any restrictions + Unique app – people are willing to pay	+ 1 <sup>st</sup> download without any restrictions + Unique app – people are willing to pay + Annual charge + Lower entre price for customers
- Low number of potential downloads - Advertising can lead to worse rating	- Onetime payment - Soon out of money → no money for update	- Higher probability people will not buy it - Loosing customers

**Table 2: pricing politics for market entry strategy, source: own creation**

The first of the three proposals is a free application with advertising that would bring revenues. The download of such an application is without any restriction or payment so it can ostensibly bring more customers. As the application is so unique with a very specific target group, there would not be any additional downloads. Naturally the advertising can be focused on the target group, which means adverts with aviation topics, but any advertising can lead to worse rating that leads to lower number of downloads. This type of pricing is suitable for games, where there is no other purpose than entertainment and it has a huge number of users.

The second proposed type is a trial version for free with one-time payment after the trial version time is up. As it was argued in the paragraph above, the application is so unique and the target group so specific that can be presumed that customers are willing to pay for it. This presumption can be substantiated by loss aversion of prospect theory, where loss has a greater impact than a gain.<sup>12</sup> In this case the customer tried the application during the trial period and found out how helpful it is. Not being able to continue in using the application is felt like a loss; thereby the user is willing to pay the fee for the application to enable him/her continuing in usage. If there was no trial version and customers had to pay immediately, then buying and purchasing of the application would be perceived as a gain. If this inequality is true

$$\text{Loss} > \text{Gain}$$

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<sup>12</sup> cf. Kahneman, Tversky (1979, 263 ff. 291)

then it applies that more customers are willing to buy the full version after trying a trial version. The disadvantage of this pricing type is that one-time payment will not cover the future necessary innovations and patching service. It is primarily a problem of low number of customers. On one hand the price could be set higher, on the other hand too high price dissuades customers from buying. This pricing type is not considered as suitable for this case.

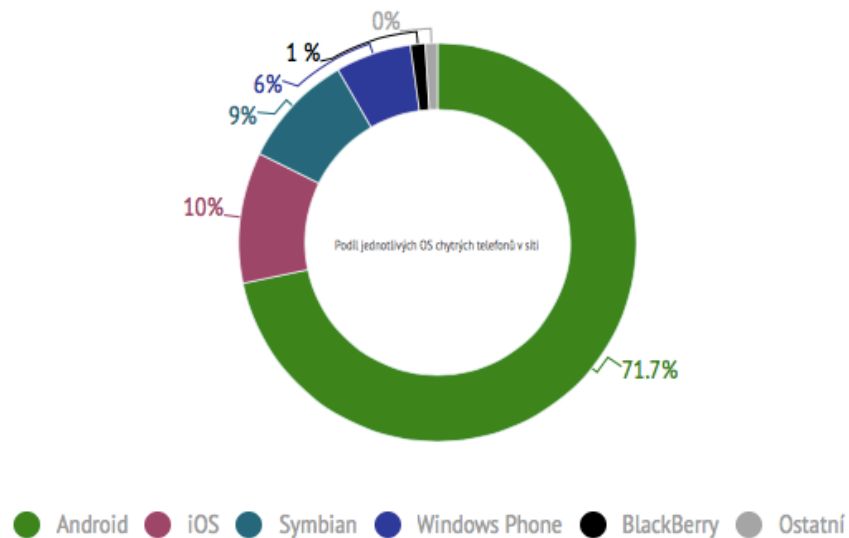
The last proposal is a trial version for free as well but with an annual fee. The advantages are again the uniqueness of the application and the willingness of customers to pay. The annual payments will ensure innovations and patching service possible as well as a lower entrance price for customers than in the case of one-time payment. There can be a higher possibility that people will not be willing to pay as they see the annual fee or it may occur that customers will not pay again after one year of using, which means losing customers. This can be prevented by an excellent service that will be provided to the users. It is important to keep customers and gain their loyalty. For example, the customer could obtain a discount after second year of using the application or any other loyalty program could be introduced.

After comparison of all three proposals, the last one seems as the most suitable and was decided to implement. It is the best option for gaining revenues and keeping a good customer service.

#### **4.3.2 Product**

The only output of the project is the application. In the point 4.3.1, it was decided that the application will be firstly provided as a trial version for free and then will be collected a fee for using the full version every year. The important message to the customer is that the trial version will be without any function restriction. There is just one limitation of the trial version that only one aircraft with its all parts and equipment can be registered. While in the full version, there will be an unlimited number of registrations of aircrafts possible.

A topic of discussion is for what operating system(s) the application should be developed. It is not wise to design the application for all mobile operating systems, because the development costs would rise rapidly and would endanger the project from the economic point of view. To answer this question a research was done that investigates, which are the most common mobile operating systems of smart phones in the Czech Republic.



**Figure 1: Operating systems of smart phones in the Czech Republic, source: FAJMON, Martin, Martion Pulzner. Pravda o podílu iOS a Windows Phone v Česku (statistiky), [online], 2015. [cit. 2017-03-05], available at: <https://mobilenet.cz/clanky/pravda-o-podilu-ios-a-windows-phone-v-cesku-statistiky-19696>**

According to Fajmon’s article<sup>13</sup>, based on data of Czech mobile operators, the most common operating system is Android. Its total share is 71 per cent. On a second place, it is iOS with its total share of 10 per cent, following Symbian, Windows Phone, BlackBerry, and others.

Based on the fact that around 80 per cent of all operating systems are Android and iOS, it was chosen to implement the application to these two.

<sup>13</sup> cf. Fajmon, Pultzner (2015)



#### 4.3.3 Promotion

It is very important to choose the right way how to inform the potential customers about the new product on a market. There is going to be implemented an advertising in a magazine, e-mail promotion, and social media marketing.

As operating aircraft specifies the target group it is appropriate to choose a magazine with flying topic. For this purpose was chosen a magazine called “Pilot” as a good communication channel to get in contact with the target group. It is a monthly magazine, which has about 7,500 copies and is distributed all over the Czech Republic. The main topics of the magazine are flying ultralight aircrafts and gliders, rotifers, helicopters, paramotor and hang gliding and paragliding. Advert in this magazine will be published on quarter of page (91 x 130 mm) 6 times per year.

Beside the advert on the quarter of page, it would be wise to pay for publishing of application review in the future. It would be short article that describes the function of the application with description of some situation, when the application was used and was very helpful. This type of promotion would probably generated higher costs but it seems like an effective way of gaining new customers.

E-mail promotion was chosen as a direct way to inform the future user. Another advantage is that it does not include costs. There are not available e-mail addresses of all operators in the Czech Republic, but it is possible to contact in this way aeroclubs. E-mails of aeroclubs are published on their web pages. The list of aeroclubs and its web pages with e-mail addresses is provided in the appendix.

For cutting off expenses for promotion it was decided to create a cost-free Facebook profile for social media marketing. It is another effective way how to stay in touch with users. It is necessary to gain followers among pilots, operators of aircrafts, and aeroclubs and stay active. Staying active on social media primarily means to share news, react on comments, follow back etc.

#### 4.3.4 Place

As an application is intangible asset it is impossible to sell in a store. It might be taken in consideration selling of coupons or gift cards, but it would indicate another costs. With such a specialized application it would not be a profitable action. The right place for selling applications is an app store. Google Play was chosen as a selling place for Android

version and Apple App Store for iOS. The costs are discussed in chapter of distribution expenses.

## **4.4 Expenditure estimation**

Before starting up a new project it is essential to set down the expenditures. There is a need to know the amount of the costs for research and development that makes the initial investment as well as how much are the operating costs.

### **4.4.1 Research and development cost**

Determination of the final price of developing mobile application is a very complex process and therefore the price will be set down approximately. There are several factors that need to be taken into consideration. Firstly it has to be realized in what operating system will be the application working. As discussed in the market entry strategy at point 4.3.2, the application will be developed for operating system of Android and iOS. Estimations about the developing team and working hours necessary for development of an application were prepared according to information published on “ackee” webpages<sup>14</sup> that are focused on developing of mobile applications. Developing team has to consist of project manager, mobile app developer, backend developer, designer, and tester. The whole process takes around 600 working hours. The calculation of the research and development costs is based on real salaries in IT sector in the Czech Republic. The hour wage averages of the workers were determined from the real month wage averages. The amounts of month salaries were divided by 160, which correspond to month working hours (8x5x4). The calculation of individual wages to workers and determination of the final research and development cost is provided in the table below.

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<sup>14</sup> For detailed information see link: <https://www.ackee.cz/blog/kolik-stoji-vyvoj-mobilni-aplikace/>

<i>Worker</i>	<i>Month average (CZK)</i>	<i>Hour average (CZK/h)</i>	<i>Working hours (h)</i>	<i>Payment (CZK)</i>
<b>Project manager</b>	80,000	500	100	50,000
<b>Mobile app developer</b>	50,000	310	200	62,000
<b>Backend developer</b>	60,000	370	150	55,500
<b>Designer</b>	30,000	190	100	19,000
<b>Tester</b>	32,000	200	50	10,000
<b>Total costs</b>				<b>196,500</b>

**Table 3: calculation of research and development costs, source: own creation based on salaries in IT sector<sup>15</sup>**

For the purpose of this thesis the final price is rounded and determined to 200,000 CZK.

#### 4.4.2 Operating costs

Operating costs are expenses, which are related to administration and maintenance of a business. To make this estimation clearer, the operating cost for this purpose will be divided into distribution expenses, advertising expenses, and maintenance expenses.

##### 4.4.2.1 Distribution expenses

Distribution expenses are determined on real prices of Google Play and Apple App Store fees and charges. Google Play subscription fee is one-time registration for \$25 USD  $\approx$  650 CZK. Apple App Store fee makes \$99 USD  $\approx$  2500 CZK per year. To transmit the currency was used an exchange rate to date of March 3, 2017. Both, Google Play and Apple App Store, are taking a 30 per cent cut of the sales that is a significant amount, which cannot be overlooked.

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<sup>15</sup> Hospodářské noviny: Nedostatkovým zbožím v tuzemsku jsou programátoři, nároky a platy rostou

	1 <sup>st</sup> year	2 <sup>nd</sup> year	3 <sup>rd</sup> year	4 <sup>th</sup> year	5 <sup>th</sup> year
Google Play	650 CZK +30% of sales	+30% of sales	+30% of sales	+30% of sales	+30% of sales
Apple App Store	2,500 CZK+ 30% of sales	2,500 CZK+ 30% of sales	2,500 CZK+ 30% of sales	2,500 CZK+ 30% of sales	2,500 CZK+ 30% of sales
<b>Total</b>	<b>3,150 CZK + 30% of total sales</b>	<b>2,500 CZK + 30% of total sales</b>	<b>2,500 CZK + 30% of total sales</b>	<b>2,500 CZK + 30% of total sales</b>	<b>2,500 CZK + 30% of total sales</b>

**Table 4: Distribution sales, source: own creation**

#### 4.4.2.2 Advertising expenses

As the creation of Facebook profile and sending e-mails is for free, those activities are not included among advertising expenses. The main expense is the advertising in the magazine. In the point 4.3.3 was determined that an advert will be printed in monthly magazine called "Pilot". According to the official price spreadsheet of magazine "Pilot" an advert 6 times per year on quarter of page (91 x 130 mm) costs 5,480 CZK<sup>16</sup>. This advertising option will be implemented for all five years that are taken into consideration for determining costs.

#### 4.4.2.3 Maintenance expenses

It is necessary to cover patching services and innovation after the development itself. There is higher probability that those services will happen more often in the first year of operating than in the following years. This presumption is based on the fact that after commissioning most of the failure will occur and it will need an immediate patching. Even though a specialist will provide the testing, it is adequate to keep in mind those increased hours of maintenance during the first year. The estimation of maintenance expenses is provided in the table below.

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<sup>16</sup> For further information see link  
<http://www.laacr.cz/SiteCollectionDocuments/Casopis%20Pilot%20LAA%20CR/ceny-tabulka-2013.pdf>

	1 <sup>st</sup> year	2 <sup>nd</sup> year	3 <sup>rd</sup> year	4 <sup>th</sup> year	5 <sup>th</sup> year
Hours/Year	100	50	50	50	50
Wage (CZK/hour)	300	300	300	300	300
Expenses (CZK)	30,000	15,000	15,000	15,000	15,000

**Table 5: Maintenance expenses, source: own creation**

## 4.5 Revenue estimation

The first three years runs the acquiring of new customers. The theoretical estimation of customers is following. The first year was estimated, that 150 customers will be gained, in the second year 300 customers, and the final estimated number of customers is 400, which makes around 40 per cent of all potential customers in the Czech Republic. The number of 400 customers might look overrated, but it has to be taken in consideration that there is no such an application on the market yet.

The following reasoning made the determination of the final number of customers. The total number of potential customers is 1000. In the figure 1, it is stated that 70 per cent of smart phones uses Android and 10 per cent iOS. That makes 700 of potential customers using Android and 100 of them using iOS. It is 800 of potential customers, who are using Android and iOS operating systems. The goal is to take over at least 50 per cent of the market in three years. 50 per cent from 800 is 400 and that is the final number of customers.

To support the estimation of future customers was made a survey. The questions that have been asked are as follows:

- Do you consider the following of AD and SIB documents difficult?
- Do you consider it as time spending?
- In the quantity of issued documents it is easy to overlook some. Is it for you stressful?
- Would you consider an application, which sorts the documents for you, as a helpful one?
- Would you be willing to pay for such an application?

The answers to those questions were processed to pie charts and can be found in appendix (point 9.2). There were 34 respondents and the conclusion is that the majority of respondents see the following of AD and SIB documents as time consuming work, that nobody likes to do. The majority agreed that an application that would sort the documents for them would be really helpful and four-fifths would be willing to pay for this kind of service. Most of the respondents stated that they will purchase the application if there is an option to test it first and if they are satisfied with the service that is provided by the application. The head of air traffic and the technic of aeroclub Beroun (Ing. Vít Zárybnický, Ing. Martin Doněk) said that an application of this kind would be more than welcomed. An application that can automatically generate the declarations to individual aircrafts and its parts would be a very helpful one.

The annual fee that can insure the continuous revenue and to cover the costs of innovation and patching service was determined to 300 CZK. The amount of 300 CZK per year is also considered as eligible for customers.

	1 <sup>st</sup> year	2 <sup>nd</sup> year	3 <sup>rd</sup> year	4 <sup>th</sup> year	5 <sup>th</sup> year
Customers	150	300	400	400	400
Payment CZK/Year	300	300	300	300	300
Revenue CZK	45,000	90,000	120,000	120,000	120,000

**Table 6: Revenue estimation, source: own creation**

## **5 Results and Discussion**

In this chapter will be discussed the economic evaluation and feasibility study of the developed application.

The application will be evaluated with internal-external analysis or so called SWOT analysis. It is a very useful tool, which gives internal (strengths, weaknesses) and external (opportunities, threats) factors about the product. Following economical evaluation by payback period, net present value, and internal rate of return method. These mentioned methods belong to management accounting methods that are mainly used for internal usage. Methods evaluate a given project in a chosen period time and give manager information if it is worth to invest in it or not. The methods are also useful for comparison of different projects.

### **5.1 SWOT analysis**

The internal-external analysis will help to determine what assists the project to achieve the desired objectives as well as what are the obstacles that are necessary to deal with or to overcome.

#### **Strengths**

The most important point about this application is that it is unique of its kind in the sense of usage for civil aviation. There is no application that would sort SIB and AD documents on the market. That makes the successful entrance more likely as there are no competitors/substitute. It is an application for very specific usage and it gives the target group.

Another thing, which can be seen as strength, is the relatively low investment needed in comparison to run a business in a store.

#### **Weaknesses**

There are several not favorable points to be considered. The potential amount of users in the Czech Republic is about 1000, which makes it a relatively small number of customers.

As a weakness can be seen the fact, that the AD and SIB documents need to be published in the format of open data, which means machine-readable form of document. Otherwise the application will not be able to process it. The question is, whether or not, EASA is willing to publish all those documents in the machine-readable format. On the other hand, there is a presumption that it will be standard to publish dataset in the format of open data in the near future. As AD and SIB documents are published on the official web pages of EASA, there are no obstacles to process them in the same way and copy the application.

If the application is successful, then it could happen that someone else would design a similar one and charge a lower fee. There is a probability that customers would start to use and prefer to buy competitor's application. Gaining customer's loyalty may prevent this situation. It could be introduced to loyal customers a discount after competitor's entrance to the market.

## **Opportunities**

There are not many apps that would be of any help for practical flying or the operation of aircrafts on the market. Nowadays there are not any competitors that are offering an application with the same or similar function. That makes a good opportunity to enter this market and to be successful.

The target group consists of private operators and aeroclubs. The minimum of purchasing power of the target group is defined and directly connected with their interest in flying. This hobby is considered as expensive one and therefore the (annual) cost of the application in comparison to all other upkeeps is low. So the opportunity is that the people of the target group have the resources and they are willing to buy an application that would help them to better manage the operating of aircrafts and more enjoy the hobby.

In the future, when the project is running well, an extension of the application could be implemented also to the other member states of EU as well as to Switzerland, Norway, Iceland, and Liechtenstein. Then it has to be taken in consideration costs connected with professional translation into different languages. A market research should be made to find out whether or not there is a market demand for such an application and if it is worth to invest in the translation. An extension that could be implemented right away is to Slovakia market. Slovakia customers can understand Czech without any difficulties and therefore

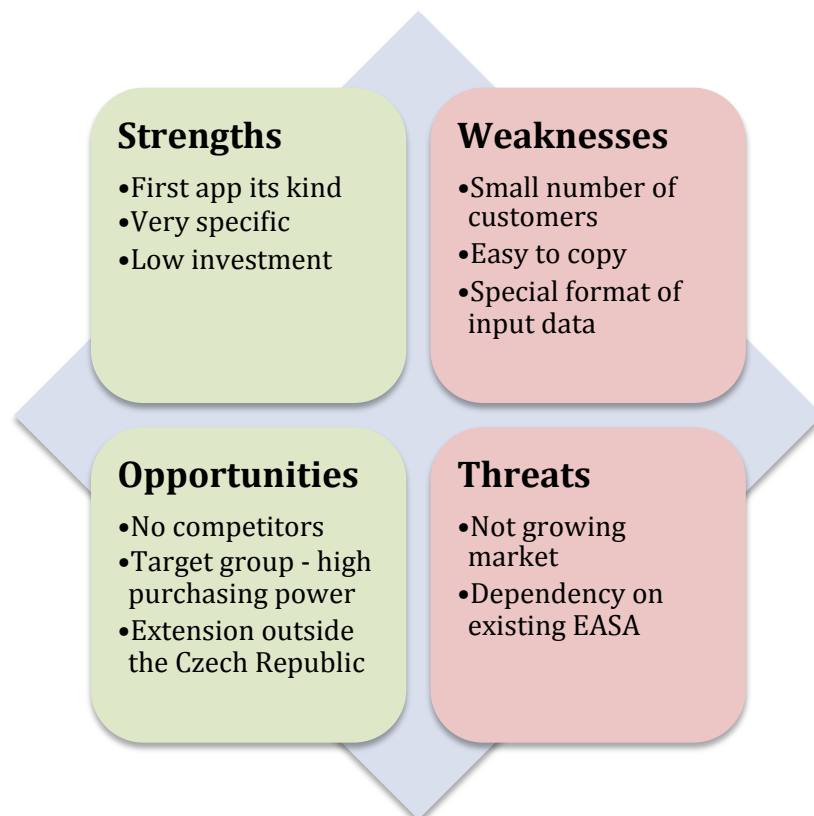


there are no costs connected with translation, when the application would be offered at Slovakia market too. To make the application as much user friendly as possible, it would be appropriate to translate it as well.

### **Threats**

In view of the fact that flying is a financially demanding hobby, it is not possible to assume any crucial increase in the size of market. There is almost no chance that the number of potential customers would extend. No indicator was found that would show a tendency of the market in the Czech Republic to grow. The potential growth of this market is directly connected with the market of private aircrafts.

Dependency on EASA could be seen as a theoretical threat. Without the existence of this institution, there are no data available. Some EU pessimists could see it as a serious threat.



**Figure 2: SWOT analysis, source: own creation**

## 5.2 Payback period

When it comes to decision-making whether or not approve a proposed project, it is very useful to know how long it will take to break even. Payback period shows the time needed to recover the costs of a project. It is a simple method, which considers only the cash flow of a given project. In the following table, there is a cash flow composed of the expenses and revenues that were determined in the preceding chapter. The payback period time is recognized in the table, where the cumulative cash flow turns to positive value. The cumulative cash flow is calculated by adding a cash flow from previous year to the actual cash flow value. Even though the second year already generates positive cash flow, there is still remaining a value that need to be cover in the following years.

Year	0	1	2	3	4	5
Development	(200,000)					
Distribution		(3,150)	(2,500)	(2,500)	(2,500)	(2,500)
30% of sales		(13,500)	(27,000)	(36,000)	(36,000)	(36,000)
Advert		(5,480)	(5,480)	(5,480)	(5,480)	(5,480)
Maintenance		(30,000)	(15,000)	(15,000)	(15,000)	(15,000)
Revenue		45,000	90,000	120,000	120,000	120,000
<b>Cash flow</b>	(200,000)	(7,130)	40,020	61,020	61,020	61,020
<b>Cumulative cash flow</b>	(200,000)	(207,130)	(167,110)	(106,090)	(45,070)	15,950

**Table 7: Payback period, source: own creation**

In the table, it is clear the payback period is between 4th and 5th year. Assuming the cash flow is spread evenly throughout the year then it is possible to calculate the exact part of the year by dividing the figure of 4<sup>th</sup> year by the sum of 4<sup>th</sup> and 5<sup>th</sup> year (ignoring negative sign). This assumption is not likely to be true, but for the purpose of this thesis, it is a convenient way of simplification the calculation. The calculation is following:

$$\frac{45,070}{45,070 + 15,950} \cong 0.7$$

The payback period is 4.7 years or 4 years and 8 months.

### 5.2.1 Discounted payback period

Discounted payback period takes in account the time value of money. The concept of the time value of money simply tells that earlier received money has higher value than a similar amount that is received later in the time. It is so because the cash collected earlier can be invested and earn interest.

In this case the interest rate according to Czech National Bank is 0.05 per cent. The interest rate is so low that it makes insignificant difference. The calculation of discounted payback period is provided in the table below and it gives the same result as the simple payback period, which takes between 4 and 5 years.

Year	0	1	2	3	4	5
Cash flow	(200,000)	(7,130)	40,020	61,020	61,020	61,020
Discount factor at 0.05%	1	0.9995	0.9990	0.9985	0.9980	0.9975
Present value	(200,000)	(7,126)	39,980	60,928	60,898	60,867
<b>Cumulative cash flow</b>	(200,000)	(207,126)	(167,146)	(106,217)	(45,319)	15,548

**Table 8: Discounted payback period, source: own creation**

### 5.3 Net Present Value

According to Collis the key definition of present net value is as follows: “Net Present Value (NPV) is a method of capital budgeting in which the value of an investment is calculated as the total of present value of all cash inflows and cash outflows minus the cost of initial investment.”<sup>17</sup> It is calculated at the discount factor ( $r$ ) of 0.05 per cent.  $C$  denotes cash flow and the calculation is following:

$$NPV = C_0 + \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \frac{C_4}{(1+r)^4} + \frac{C_5}{(1+r)^5}$$

$$NPV = -200,000 + \frac{-7,130}{(1+0.0005)^1} + \frac{40,020}{(1+0.0005)^2} + \frac{61,020}{(1+0.0005)^3} + \frac{61,020}{(1+0.0005)^4} +$$

$$+ \frac{61,020}{(1+0.0005)^5} = \mathbf{15,548}$$

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<sup>17</sup> Jill Collis et al. (2012, p.395)

The result of NPV calculation is positive, which means that in this projected time period it is worth to invest in it. The main reason for positive result is the very low interest rate. At a higher values of interest rate the project might loose its worth. When it comes to comparison a project with higher NPV value would be chosen and the one with negative value would not be accepted at all.

#### 5.4 Internal rate of return

The internal rate of return (IRR) is based on the same principals as the NPV method. NPV is set to zero and the goal is to find the proper interest rate (in this case IRR) to its equation. The obstacle is the calculation itself, when IRR is not possible to calculate analytically. It is used either trial and error method (following table) or a software for calculation of IRR.

Year	Cash flow	D.F. at 1%	Present Value	D.F. at 2%	Present Value	D.F. at 2,1%	Present Value	D.F. at 2,0848%	Present Value
0	(200,000)	1	(200,000)	1	(200,000)	1	(200,000)	1	(200,000)
1	(7,130)	0.9901	(7,059)	0.9804	(6,990)	0.9794	(6,983)	0.9796	(6,984)
2	40,020	0.9803	39,231	0.9612	38,466	0.9593	38,391	0.9596	38,402
3	61,020	0.9706	59,225	0.9423	57,501	0.9396	57,332	0.9400	57,357
4	61,020	0.9610	58,639	0.9238	56,373	0.9202	56,153	0.9208	56,186
5	61,020	0.9515	58,058	0.9057	55,268	0.9013	54,998	0.9020	55,039
NPV			<u>8,095</u>		<u>617</u>		<u>(111)</u>		<u>0</u>

**Table 9: Calculation of internal rate of return, source: own creation**

When the discount factor is set to 2 per cent then the total NPV gives relatively small number, which tells that IRR is close to 2 per cent. The next calculation of NPV with discount factor at 2,1 per cent is already negative and it is clear now that IRR lies between 2 and 2,1 per cent. The following calculation determines the exact percentage of IRR.

$$\begin{aligned}
 & \text{Positive rate} + \frac{\text{Positive NPV}}{\text{Positive NPV} + \text{Negative NPV}} * \text{Range of rates}^{18} = \\
 & = 2 + \frac{617}{617 + 111} * 0.1 = \mathbf{2.0848\%}
 \end{aligned}$$

<sup>18</sup> Jill Collis et al. (2012, p.398)

The formula gives a result of 2.0848 per cent, which is the same as the one provided by online calculator (Online calculator result can be found in appendix at point 9.3.). In the last two columns of the forgoing table is shown that at the interest rate 2.0848 per cent is NPV equal to 0, so IRR was determined correctly. When it comes to comparison, a project with higher IRR is preferred.

## 6 Conclusion

The main objective of this thesis was to propose a mobile application for civil aviation based on open data in the Czech Republic. The main goal was reached as well as the partial tasks were fulfilled.

The proposed application is working with data published by the European Aviation Safety Agency, that has a regulatory and executive power in the member states of the European union. Data necessary to run the application are available on the official web pages of EASA and there are no other obstacles to prevent the application to be successfully developed.

From the financial point of view, it is worth to make an investment if the project last at least 5 years. The payback time period is between 4 and 5 years. In today's rapidly changing environment it is relatively long period. The NPV result for the projected time period of 5 years is positive, so it is accepted for investment. There may occur an obstacle for the investment, when the interest rate rises. An increasing interest rate can make the whole project invaluable for investors and then other investments might be preferred. A difficulty in gaining profit is seen particularly in the small number of customers. Unfortunately, the manager of the project cannot affect the number of potential customers, however, the manager can control the costs.

It is questionable whether or not it is worth to invest money in development the application for two operating systems. In the subhead 4.3.2, it is clearly stated that whole 71 per cent of users have Android operating system and only 10 per cent of smart phones use iOS in the Czech Republic. If the application is developed only for Android, there could be reduction in research and development costs as well as in distribution costs, where fee for Apple App Store is much higher. Probably the pay back period would also shorten. On one hand, it is seen as a positive step to reduce costs, on the other hand, the disadvantage of this cost reduction is losing customers of iPhones. It would be a task for market research to find out how many people among operators of aircrafts in the Czech Republic use iPhone. Probably a good compromise that could be implemented is to make initial investment in developing application for operating system of Android only. After certain time, when the application is success and establishes a good reputation among

aircraft operators, it can be invested in development for iOS operating system and gain users of iPhones as well.

In the author's point of view, the application has also a non-monetary value. Using of the application will enable quick implementation of AD and SIB declaration and could help to prevent some fatal situations in flying. Even though the project would not be profitable, if some conditions changed, it is still, only for the non-monetary value, worth to realize it. If the costs were covered, it would be satisfying enough for investing in the project.

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21. PIRNEROVÁ, Helena a Michal TOŠOVSKÝ. Příloha týdeníku Ekonom. Otevřená data, jak Česko umí využít potenciál, který má internet. Praha: Economia, a.s., 2015
22. Úřad pro civilní letectví, [online], available at: <http://www.caa.cz/urad/povinne-zverejnovane-informace>
23. ZAJ, Hospodářské noviny, Nedostatkovým zbožím v tuzemsku jsou programátoři, nároky a platy rostou, [online], available at: <http://archiv.ihned.cz/c1-64175890-nedostatkovym-zbozím-v-tuzemsku-jsou-programatori-naroky-a-platy-rostou>

## 9 Appendix

### 9.1 List of aeroclubs in the Czech Republic with its web pages and e-mail addresses

<b>AEROCLUB</b>	<b>WEB PAGES</b>	<b>E-MAIL</b>
LKBE-Aeroklub Benešov	<a href="http://www.aeroklubbenesov.cz">http://www.aeroklubbenesov.cz</a>	akbenesov@gmail.com
LKBR-Aeroklub Broumov	<a href="http://www.airbroumov.eu">http://www.airbroumov.eu</a>	info@airbroumov.eu
LKBU-Aeroklub Beroun	<a href="http://www.akberoun.cz">http://www.akberoun.cz</a>	mail@akberoun.cz
LKBA-Aeroklub Břeclav	<a href="http://www.aeroklubbreclav.cz">http://www.aeroklubbreclav.cz</a>	info@aeroklubbreclav.cz
LKCE-Aeroklub Česká Lípa	<a href="http://www.aeroklub-ceskalipa.wz.cz/index_puv.php">http://www.aeroklub-ceskalipa.wz.cz/index_puv.php</a>	kubicekjindrich@email.cz
LKCL-Aeroklub Brno-Slatina	<a href="http://akbrno.cz">http://akbrno.cz</a>	inflight@iol.cz
LKCM-Aeroklub Medlánky	<a href="http://www.akmedlanky.cz">http://www.akmedlanky.cz</a>	akmedlanky@volny.cz
LKCR-Aeroklub Chrudim	<a href="http://letistechrudim.cz">http://letistechrudim.cz</a>	info@letistechrudim.cz
LKCT-Aeroklub Chotěboř	<a href="http://www.akchotebor.cz">http://www.akchotebor.cz</a>	aeroklub@akchotebor.cz
LKDK-Aeroklub Dvůr Králové nad Labem	<a href="http://www.akdk.cz">http://www.akdk.cz</a>	letiste@akdk.cz
LKFR-Aeroklub Frýdlant nad Ostravicí	<a href="http://www.akfrydlant.cz">http://www.akfrydlant.cz</a>	info@akfrydlant.cz
LKHB-Aeroklub Havlíčkův Brod	<a href="http://www.aeroklubhb.cz">http://www.aeroklubhb.cz</a>	info@aeroklubhb.cz
LKHC-Aeroklub Hořice	<a href="http://www.lkhc.cz/cz/">http://www.lkhc.cz/cz/</a>	aeroklub@lkhc.cz
LKHD-Aeroklub Hodkovice	<a href="http://www.hodkovice.info">http://www.hodkovice.info</a>	info@hodkovice.info
LKHN-Aeroklub Hranice	<a href="http://www.aeroklubhranice.cz">http://www.aeroklubhranice.cz</a>	aeroklub.hranice@seznam.cz
LKVP-Aeroklub Hronov	<a href="http://www.lkvp.cz">http://www.lkvp.cz</a>	lkvp@lkvp.cz
LKHO-Aeroklub Holešov	<a href="http://www.aeroklubholesov.cz/index.php/Cs/">http://www.aeroklubholesov.cz/index.php/Cs/</a>	*
LKHS-Aeroklub České Budějovice	<a href="http://www.letiste-hosin.cz">http://www.letiste-hosin.cz</a>	aeroklub.hosin@pohoda.com
LKCH-Aeroklub Chomutov	<a href="http://www.aeroklub-chomutov.com">http://www.aeroklub-chomutov.com</a>	libor.pasek@seznam.cz
LKJA-Aeroklub Jaroměř	<a href="http://www.lkja.cz">http://www.lkja.cz</a>	aeroklub@lkja.cz
LKJC-Aeroklub Jičín	<a href="http://www.letistejicin.info">http://www.letistejicin.info</a>	info@letistejicin.info
LKJH-Aeroklub Jindřichův Hradec	<a href="http://www.letistejh.cz">http://www.letistejh.cz</a>	akjh@letistejh.cz
LKJI-Aeroklub Jihlava	<a href="http://www.aeroklub-jihlava.cz">http://www.aeroklub-jihlava.cz</a>	info@aeroklub-jihlava.cz
LKKA-Aeroklub Křižanov	<a href="http://www.lkka.cz">http://www.lkka.cz</a>	LKKA@LKKA.CZ
LKKL-Aeroklub Kladno	<a href="http://www.akkladno.cz/web/">http://www.akkladno.cz/web/</a>	akkladno@volny.cz
LKKM-Aeroklub Kroměříž	<a href="http://www.lkkm.cz">http://www.lkkm.cz</a>	letiste.km@tiscalia.cz
LKKO-Aeroklub Kolín	<a href="http://www.aeroklub-kolin.cz">http://www.aeroklub-kolin.cz</a>	info@kolin-letiste.cz
LKKR-Aeroklub Krnov	<a href="http://www.letistekrnov.cz">http://www.letistekrnov.cz</a>	krnovinfo@letistekrnov.cz
LKKT-Pošumavský Aeroklub Klatovy	<a href="http://www.lkkt.cz">http://www.lkkt.cz</a>	info@lkkt.cz
LKKU-Aeroklub Kunovice	<a href="http://www.slovackyaeroklub.cz">http://www.slovackyaeroklub.cz</a>	info@slovackyaeroklub.cz
LKKV-Aeroklub Karlovy Vary	<a href="http://aeroklub-kv.cz">http://aeroklub-kv.cz</a>	aeroklub.kv@volny.cz
LKLB-Aeroklub Liberec	<a href="http://www.aeroklubliberec.cz">http://www.aeroklubliberec.cz</a>	aeroklubliberec@centrum.cz
LKLT-Aeroklub Praha - Letňany	<a href="http://www.akletnany.cz/cs/">http://www.akletnany.cz/cs/</a>	posta@akletnany.cz
LKMB-Aeroklub Mladá	<a href="http://www.akmb.cz/htm_cz/akmb_00.htm">http://www.akmb.cz/htm_cz/akmb_00.htm</a>	akmb@akmb.cz

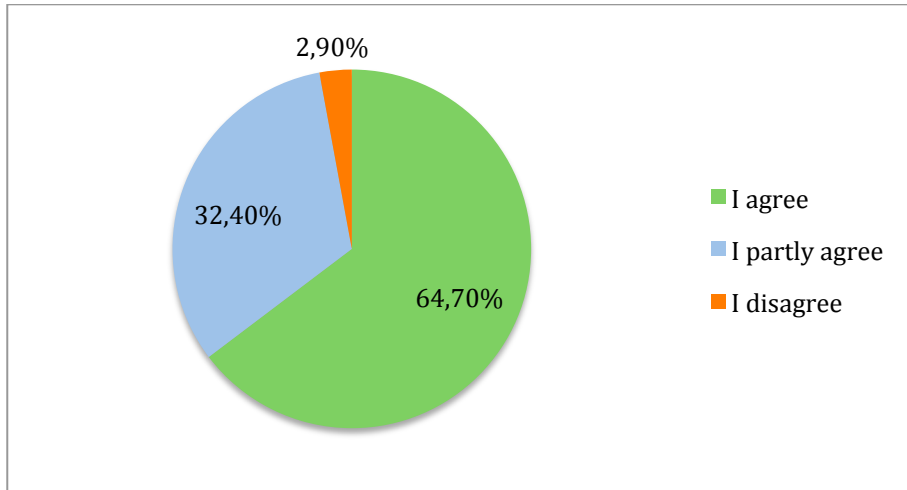
## Boleslav

LKMI-Aeroklub Jeseník	<a href="http://www.aeroklubjesenik.cz">http://www.aeroklubjesenik.cz</a>	<a href="mailto:info@aeroklubjesenik.cz">info@aeroklubjesenik.cz</a>
LKMK-Aeroklub Moravská Třebová	<a href="http://www.lkmk.com/index.php/cs/">http://www.lkmk.com/index.php/cs/</a>	<a href="mailto:lkmk@lkmk.com">lkmk@lkmk.com</a>
LKMO-Aeroklub Most	<a href="http://www.letistemost.cz">http://www.letistemost.cz</a>	<a href="mailto:aeroklub-most@volny.cz">aeroklub-most@volny.cz</a>
LKPA-Aeroklub Polička	<a href="http://www.lkpa.cz">http://www.lkpa.cz</a>	<a href="mailto:info@lkpa.cz">info@lkpa.cz</a>
LKPI-Aeroklub Přebyslav	<a href="http://lkpi.cz">http://lkpi.cz</a>	<a href="mailto:lkpi@lkpi.cz">lkpi@lkpi.cz</a>
LKPJ-Aeroklub Josefa Františka Prostějov	<a href="http://www.lkpi.cz">http://www.lkpi.cz</a>	*
LKPL-Aeroklub Plzeň - Letkov	<a href="https://akletkov.cz">https://akletkov.cz</a>	<a href="mailto:info@akletkov.cz">info@akletkov.cz</a>
LKPM-Aeroklub Příbram	<a href="http://akpm.cz">http://akpm.cz</a>	<a href="mailto:info@akpm.cz">info@akpm.cz</a>
LKPN-Východočeský Aeroklub Pardubice	<a href="http://www.letistepodhorany.cz">http://www.letistepodhorany.cz</a>	<a href="mailto:info@letistepodhorany.cz">info@letistepodhorany.cz</a>
LKPS-Aeroklub Plasy	<a href="http://www.akplasy.cz">http://www.akplasy.cz</a>	<a href="mailto:info@akplasy.cz">info@akplasy.cz</a>
LKRA-Aeroklub Raná	<a href="http://aeroklubrana.cz">http://aeroklubrana.cz</a>	<a href="mailto:info@aeroklubrana.cz">info@aeroklubrana.cz</a>
LKRO-Aeroklub Roudnice nad Labem	<a href="http://www.aeroklubroudnice.cz">http://www.aeroklubroudnice.cz</a>	<a href="mailto:rada@aeroklubroudnice.cz">rada@aeroklubroudnice.cz</a>
LKSA-Aeroklub Staňkov	<a href="http://www.ak-stankov.org/cs/uvodni-stranka">http://www.ak-stankov.org/cs/uvodni-stranka</a>	<a href="mailto:akstankov@seznam.cz">akstankov@seznam.cz</a>
LKSK-Aeroklub Skuteč	<a href="http://www.letisteskutek.cz">http://www.letisteskutek.cz</a>	<a href="mailto:ak.skutek@seznam.cz">ak.skutek@seznam.cz</a>
LKSN-Aeroklub Slaný	<a href="http://www.lksn.cz">http://www.lksn.cz</a>	<a href="mailto:radaakslany@slansko.cz">radaakslany@slansko.cz</a>
LKSR-Aeroklub Prachatice	<a href="http://www.ak-pt.cz">http://www.ak-pt.cz</a>	<a href="mailto:info@ak-pt.cz">info@ak-pt.cz</a>
LKSU-Aeroklub Šumperk	<a href="http://www.aeroklub-sumperk.cz">http://www.aeroklub-sumperk.cz</a>	<a href="mailto:info@aeroklub-sumperk.cz">info@aeroklub-sumperk.cz</a>
LKSZ-Aeroklub Kralupy nad Vltavou - Sazená	<a href="http://lksz.sweb.cz/index.html">http://lksz.sweb.cz/index.html</a>	<a href="mailto:lksz@seznam.cz">lksz@seznam.cz</a>
LKTA-Aeroklub Tábor	<a href="http://www.aktabor.cz">http://www.aktabor.cz</a>	<a href="mailto:info@aktabor.cz">info@aktabor.cz</a>
LKTC-Aeroklub Točná	<a href="http://www.aktocna.cz">http://www.aktocna.cz</a>	<a href="mailto:tocna@seznam.cz">tocna@seznam.cz</a>
LKTD-Aeroklub Tachov	<a href="http://www.letistetachov.cz">http://www.letistetachov.cz</a>	*
LKTO-Aeroklub Toužim	<a href="http://www.lkto.cz">http://www.lkto.cz</a>	<a href="mailto:aktouzim@volny.cz">aktouzim@volny.cz</a>
LKUO-Aeroklub Ústí nad Orlicí	<a href="http://www.lkuo.cz">http://www.lkuo.cz</a>	<a href="mailto:ak@lkuo.cz">ak@lkuo.cz</a>
LKVL-Aeroklub Vlašim	<a href="http://www.lkvl.cz">http://www.lkvl.cz</a>	<a href="mailto:info@lkvl.cz">info@lkvl.cz</a>
LKVM-Aeroklub Vysoké Mýto	<a href="http://www.lkvm.cz">http://www.lkvm.cz</a>	<a href="mailto:aeroklub.vm@wo.cz">aeroklub.vm@wo.cz</a>
LKVR-Aeroklub Vrchlabí	<a href="http://www.akvr.estranky.cz">http://www.akvr.estranky.cz</a>	<a href="mailto:akvr@seznam.cz">akvr@seznam.cz</a>
LKVY-Aeroklub Vyškov	<a href="http://www.aeroklubvyskov.cz/AKVY">http://www.aeroklubvyskov.cz/AKVY</a>	<a href="mailto:aeroklubvyskov@aeroklubvyskov.cz">aeroklubvyskov@aeroklubvyskov.cz</a>
LKZA-Aeroklub Zábřeh	<a href="http://www.lkza.cz">http://www.lkza.cz</a>	<a href="mailto:aeroklub@lkza.cz">aeroklub@lkza.cz</a>
LKZB-Aeroklub Zbraslavice	<a href="http://www.lkzb.cz">http://www.lkzb.cz</a>	<a href="mailto:info@lkzb.cz">info@lkzb.cz</a>
LKZM-Aeroklub Žamberk	<a href="http://www.aeroklub.zamberk.cz">http://www.aeroklub.zamberk.cz</a>	<a href="mailto:info@aeroklub.zamberk.cz">info@aeroklub.zamberk.cz</a>

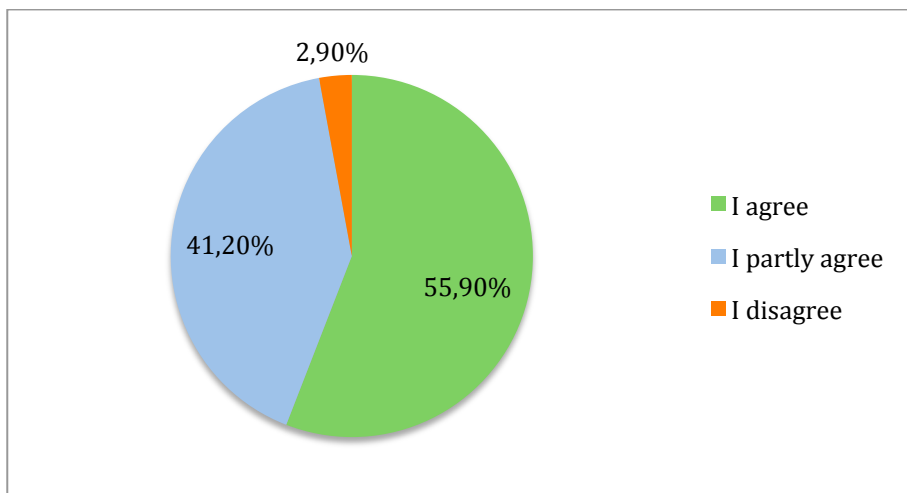
\* E-mail form on its web pages

## 9.2 Processed answers of a survey

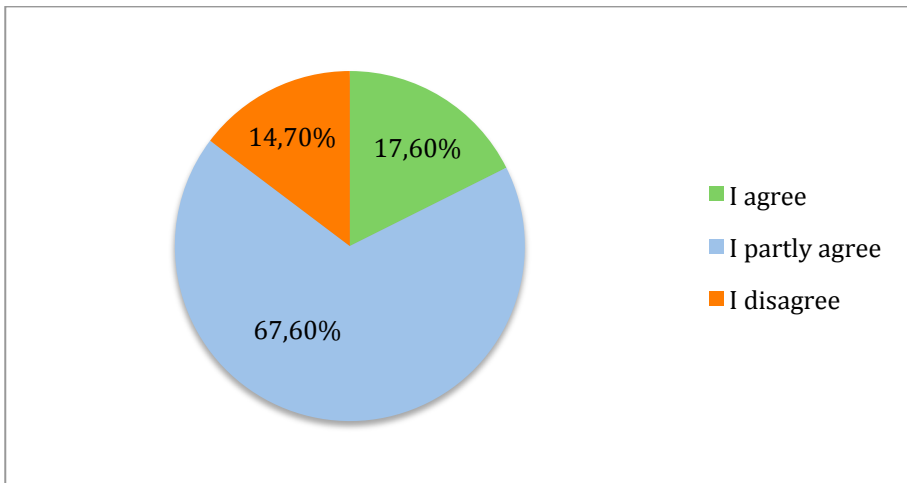
- Do you consider the following of AD and SIB documents difficult?



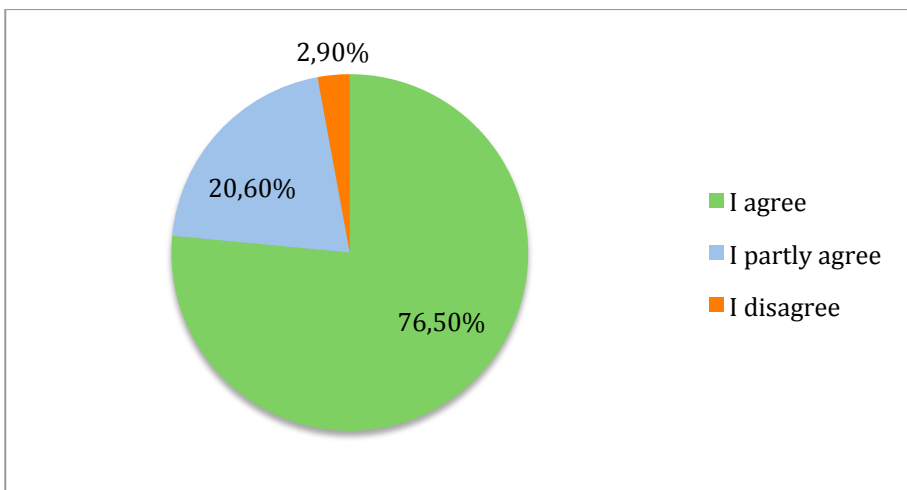
- Do you consider it as time spending?



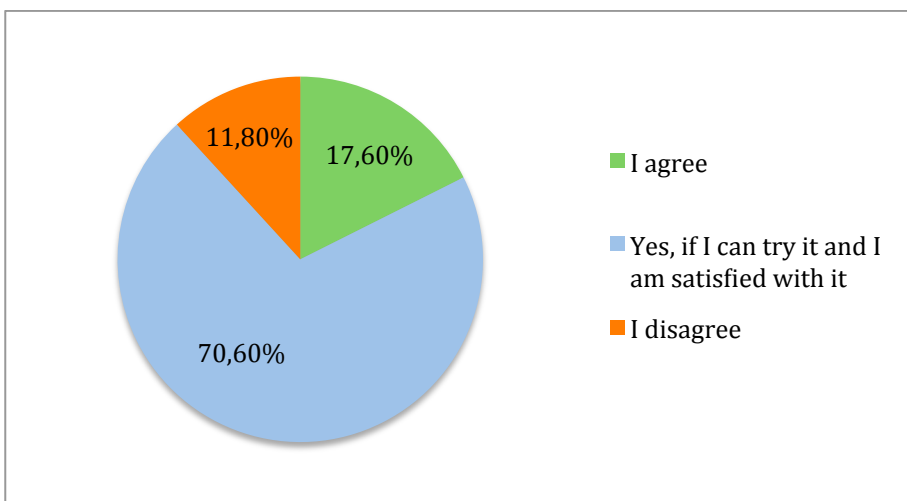
- In the quantity of issued documents, it is easy to overlook some. Is it for you stressful?



- Would you consider an application, which sorts the documents for you, as a helpful one?



- Would you be willing to pay for such an application?



### 9.3 Online calculation of IRR

The internal rate of return (IRR) is a rate of return used in capital budgeting to measure and compare the profitability of investments.

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**Initial Data**

Number of Cash flows:  See also: [NPV and Profitability Index \(PI\)](#)

Time Horizon (Years)	Cash-In	Initial investment/ Cash-Out	Net Cash Flow
0	0	200000	-200000
1	45000	52130	-7130
2	90000	49980	40020
3	120000	58980	61020
4	120000	58980	61020
5	120000	58980	61020
<b>Total</b>	<b>Total Inflow</b> 495000.00	<b>Total Outflow</b> 479050.00	<b>Total Net Flow</b> 15950.00

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**Result**

Internal Rate of Return (IRR):  %

Source: Internal Rate of Return (IRR) Calculator, <http://www.calkoo.com/?lang=3&page=26>