**MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF**

**KAZAKHSTAN**

**“Kazakh-British Technical University” JSC**

**Faculty of Information Technologies**

**ADMITTED TO DEFENCE**

Dean of FIT,

Professor, PhD

\_\_\_\_\_\_\_\_\_\_\_ F.A. Hajiyev

“\_\_\_”\_\_\_\_\_\_\_\_\_\_\_ 2018

**EXPLANATORY NOTE**

**TO GRADUATION PROJECT (work)**

**Theme**: “New approaches to entrepreneurship ecosystems design and development”

**Consultant on economic issues: Supervisor**

Professor,

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ R. Kini

“\_\_\_”\_\_\_\_\_\_\_\_\_\_\_\_ 2018

**Student**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_S.A. Seidigalimov

“\_\_\_”\_\_\_\_\_\_\_\_\_\_\_\_ 2018

**Major:** 5B070300

"Information Systems”

Professor,

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ R. Kini

“\_\_\_”\_\_\_\_\_\_\_\_\_\_\_\_\_ 2018

**Consultant on occupational health**

**and safety measures :**

Senior lecturer, MSc

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ G.S. Berdibekov

“\_\_\_”\_\_\_\_\_\_\_\_\_\_\_\_\_ 2018

**Norms Compliance Monitor**

Lecturer, MSc

\_\_\_\_\_\_\_\_\_\_\_\_ E.S. Seitbekova

“\_\_\_”\_\_\_\_\_\_\_\_\_\_\_\_ 2018

**Almaty, 2018**

**MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN**

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**Specialty 5B070300 “Information Systems”**

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Dean of FIT,

Professor, PhD

\_\_\_\_\_\_\_\_\_\_\_ F.A. Hajiyev

“\_\_\_”\_\_\_\_\_\_\_\_\_\_\_ 2018

**DIPLOMA PROJECT ASSIGNMENT**

Student: Serik Seidigalimov

Project title: “New approaches to entrepreneurship ecosystems design and development”

Approved by the KBTU order: № \_\_\_\_\_\_\_dated “\_\_\_” \_\_\_\_\_\_\_\_\_\_\_

Submission deadline: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

List of issues addressed in the diploma project or its brief content:

1. Research section.
2. Theory
3. Methods
4. Business modulation and simulation
5. Project results
6. Mobile application
7. Economic section.
8. Occupational health and safety section.

List of graphics (with precise indication of obligatory drawings):

1. Tables (15).
2. Figures (13).

Consultations regarding the project with indication of respective reasons:

|  |  |  |  |
| --- | --- | --- | --- |
| Section | Consultant  (academic degree, title) | Timeline | Signature |
| Main | Ramesh Kini,  Professor |  |  |
| Special | Ramesh Kini,  Professor |  |  |
| Economic | Ramesh Kini,  Professor |  |  |
| Occupational health and safety | Galamat Berdibekov,  Senior lecturer, MSc |  |  |

**DIPLOMA PROJECT WORK SCHEDULE**

|  |  |  |
| --- | --- | --- |
| Sections, issues addressed | Submission deadline | Notes |
| Main |  |  |
| Special |  |  |
| Occupational health and safety |  |  |
| Economic |  |  |

Project supervisor \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ R. Kini

(signature)

Student \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_S.A. Seidigalimov

(signature)

Date «\_\_\_\_» \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_2018

**Project sheet**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| № | Format | Designation | Denomination | Quantity | Note |
| 1 | А4 |  | Explanatory note | 2 | 66p |
| 2 | .docx |  | Electronic copy of the diploma project | 1 |  |
| 3 | .pptx |  | Presentation Files | 1 |  |

**ABSTRACT**

The explanatory note contains 66 typewritten pages, 15 tables, 13 charts and graphs, list of references – 11 references, 2 appendices.

NEW APPROACHES TO ENTREPRENEURSHIP ECOSYSTEMS DESIGN AND DEVELOPMENT

The object of the diploma project is to compare start-ups with other types of businesses and provide the most flexible method of valuation so that investors and owners could come to the common agreement.

"Research section" provides information about start-up definition, problem of start-ups and for whom this project will be useful.

"Theory" provides the detailed description of all needed financial instruments and how the investment decisions are made.

"Methods" provides information about the existing approaches for valuing any type of the company.

"Business modulation and simulation" section provides a research and valuation of established business, which is real estate and start-up, which is called replicon.

"Projects results" section compares the results of start-up and established business.

"Mobile Application" is the implementation of an iOS mobile application and its basic concept.

"Economic section" deals with the profitability, the total revenue and the cost of production in the implementation of the system.

"Occupation health and safety" includes information on labour, fire and industrial safety and health of workers.

**АҢДАТПА**

Дипломдық жоба 66 бет, 15 кесте, 13 сурет, 11 әдебиеттер тізімі және 2 қосымшалардан құрылған.

КӘСІПКЕРЛІК ЖҮЙЕ ЖАҢА ӘДІС-ТӘСІЛДЕРІНІҢ МӘНІ ЖӘНЕ ҚҰРЫЛЫМЫ.

Дипломдық жұмыстың мақсаты стартап және ұйымдастырылған бизнестің құралымын салыстырып, жаңа икемді компания бағалау әдіс-тәсілді қолданып, соңғы нәтижелерді қарамағына беру.

«Зерттеу бөлімі» тақырыбы стартап компания туралы, оның негізгі мәселесі және мақсатты аудиторияны анықтау.

«Теория» бөлімінде қаржы құралдар туралы мәлімет қамтылады. Онымен қатар инвестиция шешім туралы ақпарат қосылған.

«Тәсілдер» бөлімі шынайы компания бағалау әдіс-тәсілдер туралы ақпарат береді.

«Бизнес модуляция және көлгіру» бөлімі 2 әр-түрлі бизнестердің көлгіруің зерттейді. Қарастырылатын бизнестер ол: старап компания және жылжымайтын мүлік бизнесі.

«Жобаның нәтижелері» бөлімі 2 бизнестердің нәтижелерін салыстырады.

«Мобильдік қолдаңба» бөлімі iOS мобильдік қолданбаның құралы туралы мәлімет қамтиды.

«Экономикалық бөлімі» табыстылығы, жалпы кірістер менжүйені өндіріске енгізуқұны туралы мәліметін қамтиды.

«Еңбек қорғау және қауіпсіздік» бөлімі еңбек, өрт және қызметкерлердің өнеркәсіптік қауіпсіздік және денсаулық сақтау туралы ақпаратты қамтиды.

**АННОТАЦИЯ**

Дипломный проект содержит 66 страницы машинописного текста, 15 таблиц, 13 рисунков, список использованных источников – 11 наименований.

НОВЫЕ МЕТОДЫ СИСТЕМЫ ПРЕДПРИНИМАТЕЛЬСТВА И ИХ СТРУКТУРА И ИСПОЛЬЗОВАНИЕ.

Целью дипломной работы является сравнение старап компаний и уже сформировавшихся бизнесов и примение гибкого метода оценки компаний для того, чтобы инвесторы и владельцы стартап компаний могли найти общий язык.

Раздел «Исследовательская часть» предоставляет информацию об изучений структуры стартап компаний, финансовой отчетности, и выявление целевой аудитории.

Раздел «Теория» предоставляет детальное описание финансовой отчетности, финансовых инструментов и о том как принимаются инвестиционные решения.

Раздел «Методы» предоставляет информацию о существующих методах оценки компаний.

Раздел «Бизнес модуляция и симуляция» предоставляет исследование, симуляцию и оценку двух бизнесов: рынок недвижимости и старап компании.

Раздел «Результаты исследований» содержит сравнение результатов двух бизнесов, которые были получены после исследований и симуляции.

Раздел «Мобильное приложение» предоставляет детальное описание разработку мобильного iOS приложения.

«Экономический раздел» рассматривает рентабельность, общий доход и затраты на производство при внедрении системы.

Раздел «Охраны труда и техники безопасности» содержит информацию о трудовой, пожарной и промышленной безопасности и здравоохранении работников.

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# INTRODUCTION

Diploma project represents how start-ups ecosystem is constructed and considers why this kind of business is specific compared to already established businesses. The project mostly oriented to the valuation of start-ups and shows that traditional methods of valuing do not provide so many insights. The main purpose of my diploma project to compare start-ups with other types of businesses and provide the most flexible method of valuation so that investors and owners could come to the common agreement.

To realize my main purpose I am going to use a hotel industry, which belongs to the established business, as a comparison to the start-up company. According to my plan I'm going to reflect financial information of both to excel and try to simulate their future incomes and costs. All the simulated data will be shown with the usage of tornado and spider charts. With estimated forecasts to the future cash flows, I will be able to calculate expected Net Present Value of those companies. Having financial information, I will use 2 different methods of company valuation to established business and start-up, where in the result I will get a clear comparison of different types of businesses.

The diploma project is expected to describe the following sections:

1. Research Section;
2. Theory;
3. Methods;
4. Business modulation and simulation;
5. Project results;
6. Mobile application;
7. Economic section;
8. Occupational health and safety section.

Now I would like to briefly explain the main idea of each section that were mentioned above. In the Research section, I determine what is a start-up and its advantages and disadvantages. This part describes what kind of problems it meets and why is it important to solve them at the initial stage of start-up. Additionally, I will specify to what kind of professionals, my diploma project will be beneficial.

The next stage of my project is called theory, where I am going to introduce the basis financial aspects of company structure, investments, company valuation.

The section methods considers the ways of company valuation. In this stage I'm planning to describe what kind of traditional ways of valuation exist and focus on new approaches of valuing and distinguish their advantages compared to traditional methods.

The next section called technical implementation is the most important part of diploma project. In this stage I am going to reflect the theory in real numbers and run simulations. Based on generated data, there will be constructed a graph that will show us the full picture of this diploma project. Moreover, there will be explained how simulations are working, what formulas are used.

The economic section was based on estimations of human resources exploited in the given diploma project. Creating a software product as well as any other product, must be justified also from an economic point of view. In this section I described calculation of time necessary for creation of web-platform, calculation of payroll and cost of purchased IT equipment.

The occupational health and safety section describes the system of acts of law, social and economic, organizational, technical, medical and preventive arrangements and facilities, ensuring safety, preservation of health and human performance on the job.

The last part of the project will conclude about all argument for and against start-up valuation and its importance. Additionally, based on the simulated data and other estimation, I am going to make some predictions about start-up development in Kazakhstan.

# 1 RESEARCH SECTION

## Start-up definition

The term «start-up» I heard for the first time when I studied in the 2nd course. When I studied in the 2nd course, there was an organization called «Techgarden» that help to new start-uppers to promote their prototypes and find new investors for them. After that I got interested in this direction.

In our 21st century there are a lot of companies that started from almost nothing and rapidly reached the success and become well-known companies. People throughout the world are coming with the bright ideas, work on it and deliver the final innovative product to the society, which in the result will impact on it.

Of course, it is wonderful that some unknown people create such technological products and in the result become millionaires, or even billionaires. Before, such people start from zero and become rich, the majority of people had an opinion that it is impossible to reach such peaks and the only to be a rich guy is to born in a family of president or in a family of billionaire. However, such people proved the opposite and the popularity of such type of business captured the attention of the whole world. Communities talk about start-ups, but the only thing that they know is that it can bring a million dollars, and they do not understand it even briefly.

There are a lot of formulations of start-ups and each of them sounds differently. According to Timmons and Spinelli (2008) start-up companies are raw companies that have an innovative idea that develops into a high-growth company. The success relies on strong leadership from the main entrepreneur and on building a team with complementary talents. Giardino et al. (2014) write that startups are newly created companies with little or no history facing high volatility in technologies and markets. The start-up ecosystem is difficult to predict, because it is dynamic and every time it forces managers to make quick decisions, avoid failures and find a market where their product will be demanded. Actually start-up could be a product that can significantly impact on society, and they way we live. Nowadays all start-ups refer to the high-technology sectors, but it does not have to be. According to Giardino et al, the probability of failure of start-ups in first five years of existence is more than sixty percent. On the other side, if start-up will be successful, it can gain 10 times more than it was initially invested.

10x of the investment sounds spellbinding and when people earn such amount of money, it seems that it is so easy. Unfortunately, it is not. What we see on the front-side is only the final product, we just use and do not even try to think how it is working or how it was made, but not everyone realises what is going on the backside. On the backside, programmers think about the structure of the product and try to optimize as much as it's possible, so that it will work properly without crashes. Start-up owners spend massive amount of time to find out investors, who are extremely needed for them, because only money makes money.

The hardest part of job lies on the shoulders of company owners and promoters. They need to convince investors so that they will be interested and invest into project with hope that in future it will become a huge company, and they will be part of it, and earn much more money than they invested. Although investors want to put their dollars into modern project, they will not invest immediately. Investors are very smart people, and they know how market is constructed and in what way cash is flowing. When they are investing they are trying to take the biggest part of the pie. Owners of a new company do not want to give the major part of equity; otherwise they will lose control over company that they were building for a long time. Such situations come to the question of company valuation, so that each side will get a fair part. This is only a tip of the iceberg, but it enough to understand how difficult start-ups are made.

## 1.2 Problem statement

As it was mentioned before start-up is a new type of business and just like other businesses, it needs financing to realize their idea into product and then it will be promoted to the market. Compared to the old and established businesses, this type of entrepreneurship gain investment from business angels or venture capitalists(risk investors) and from friends and family (Brealey et al., 2011). However, outside investment will bring only small amount of money, because there is a lack of financial history and the business idea was not tested before. At this stage we can clearly see the root of disease of all start-up companies. Most of the good start-up companies cannot rocket, because investors are scared about their money and if there is a little loss, they want to take their money back by which they do not consider future potential. The problem of all investments is that all decisions are made today and right now. Traditional methods of valuation assume that the investment is an all-or-nothing strategy and do not account for managerial flexibility, the concept that management can alter the course of an investment over time when certain aspects of the project’s uncertainty become known (Dr. Jonathan Mun, 2006). Therefore, such kind of approach makes it more risky. Consequently, with the growth of risk, the number of investors will decrease, which in the result leave potential start-ups without financing.

This problem will cause a chain of other issues like how much of equity will belong to investor, what kind of shares he will own and so on. Of course, the whole entrepreneurship is all about negotiation and trading, but in order to negotiate in a particular question both side have to have the same knowledge, otherwise they will never come to common agreement. Therefore, all financial questions about start-ups spin around the problem of valuation.

## 1.3 Target group

Actually this project will be useful for business people and employees. In this ecosystem there exist 3 types: young specialists, investors, and company owners or entrepreneurs.

Founders are first people who will find it beneficial, because compared to investors and young employees, they need to understand their business as clear as its possible. Often, potential start-ups crash because of wrong financial management. Company owners are those people who make decisions and if their business fails, it is because of their management. Therefore, founders are primary target for my diploma project.

Investors are people who are interested in success of the start-up and being part of a team so that in the result it will bring much more money than it was invested. My diploma project is also targeted to investors, because they are part of the system that I’m creating. The diploma project considers the perspective of investors very carefully, because in the result there should be created a bridge so that founders could find a common language with them. The research will include the flexibility of investments, which will positively impact to the deals.

The last category of business ecosystem is young specialists. Usually business environment consider them as labour, and they are those who just should do a job, but actually they should understand what they are doing and for what purpose is this. My project will help them understand the whole business environment so that they can see what role do they play.

# 2 Theory

## 2.1 Financial statement

When people talk about any business they only know about such things like revenue, cost and profit. Actually, the financial system of any company is much more complicated. Actually this part of job fully belongs to accountant, but both investors and owners must know how do money flow. Financial statement or report is a formal record for the financial activities and position of a business. Usually financial statement consists of 4 major parts:

* Balance sheet
* Income statement
* Cash flow statement
* Statements of retained earnings or equity statement

These 4 reports reflect the whole picture of the current business. Based on this data company owners or business analysts can figure out is business works properly, if not they can find out where is the problem. Moreover, relying on this financial information and analysing the performance of the enterprise, business people can make predictions for the nearest quartery or year. These statements are the lifeblood of any company and understanding them is key to finding investment opportunities. Each of them will be described further.

According to Investopedia, which is a world’s leading source of financial content on the web, balance sheet provides an overview of assets, liabilities and stakeholders' equity as a snapshot in time. The date at the top of the balance sheet tells you when the snapshot was taken, which is generally the end of the fiscal year. The balance sheet equation is assets equals liabilities plus stockholders' equity, because assets are paid for with either liabilities, such as debt, or stockholders' equity, such as retained earnings and additional paid-in capital. Assets are listed on the balance sheet in order of liquidity. Liabilities are listed in the order in which they will be paid. Short-term or current liabilities are expected to be paid within the year, while long-term or noncurrent liabilities are debts expected to be paid after one year.

The next financial report is called income statement. Unlike the balance sheet, the income statement covers a range of time, which is a year for annual financial statements and a quarter for quarterly financial statements. This type of financial report provides an overview of revenues, expenses, net income and earnings per share. It usually provides two to three years of data for comparison. The structure of income statement is broken into several parts:

* Income from continuing operations
* Results from discounted operations (if any)
* Extraordinary items (if any)
* Cumulative effect of a change in accounting principle (if any)
* Net income
* Other comprehensive income
* Earnings per share information

The most important part of income statement is income from continuing operations, which includes sales or revenue, cost of goods sold, operating expenses, gains and losses, other revenue and expense items that are unusual or infrequent but not both, and income tax expense.

One of the important financial report is called cash flow statement. This type of financial report summarizes the amount of cash and cash equivalents entering and leaving a company (C.B.Murphy, 2018). The cash flow statement (CFS) estimates how well a company manages its cash position, which means that does company generate enough cash to pay its debt obligations and operating expenses. In fact, this type is complementary for the balance sheet and income statement, but it is mandatory for any company's financial report. Even though it is like an addition to the previous statements, it has its own specifics. This report allows investors to understand how company's operations are running, where its money coming from, and how money is being spent. On the other hand, it can be used by creditors to determine how much cash is available (referred as liquidity) for the company to fund its operating expenses and pay its debts (C.B.Murphy, 2018). The main components of the statement are:

* Cash from operating activities
* Cash from investing activities
* Cash from financing activities
* Disclosure of non cash activities

Usually the last activity is sometimes included when prepared under the generally accepted accounting principles, or GAAP. Compared to balance sheet and income statement, cash flow statement's specificity is that it does not include the amount of future incoming and outgoing cash that has been recorded on credit (C.B.Murphy, 2018). For example, if somebody bought your product partly, which costs $200, and paid only $100 in income statement it will be recorded as $200, whereas in cash flow it will be recorded as $100. Therefore, this statement is called cash flow statement, because with cash the person paid only $100.

The last part of financial report is statement of retained earnings or equity statement. Equity statement outlines the changes in retained earning for a specified period. It reconciles the beginning and ending retained earnings for the period, using information such as net income from the other financial statements. Retained earnings can refer to any profits made by an organization that it decides to keep for internal use. Additionally, it can be referred to as retained profit, accumulated earnings or accumulated retained earnings. The main purpose of this financial report is to improve market and investor confidence in the organization. It is used like a marker to help analyse the health of the organization.

## 2.2 Investment decision and its valuation

The background of any company are their real assets, which can be used to provide goods and services that are sold to the customers. In our 21st century the bright example is a computer, which is used by different kinds of specialists to print the documents, send emails, create websites and so on. In this ecosystem the decision to purchase a real asset is usually called investment decision. When the company makes many investment decisions to buy real assets during the period is called capital budgeting or capital expenditure (CAPEX) decisions (O.A.Leskisenoja, 2015).

All real assets have their costs and in order to get them, companies finance their investments through financial assets or securities. For instance, it can be bank loans, corporate bonds or stocks to stockholders. With money that has been gathered from investment, company can buy either tangible assets – things that we can see and touch – or intangible assets – for example, company can spend money to do research and development (R&D) (O.A.Leskisenoja, 2015, p.13). The bright example of R&D is a biochemical company's decision to figure out possible results and after that make final decision. Such investment decisions are also included into capital budgeting.

There should be a difference between investment decision and financing decision. Investment and financing decisions are similar to strategy and tactics. In this case, investment decision is a strategy that is for looking for the long-term period purposes, whereas financing decisions are tactics, which is part of strategy and it answers to question how to, and they are done in short periods. For instance, investment decision is to buy computers, then to do it company need money, and they find it by borrow money from banks (debt financing) or raise money from present or future stockholders (equity financing), which is a financing decision.

However, when money come from outside they are not free and any company has to repay those moneys to banks, bondholders or as dividend or stock repurchase to stockholders at certain period. When company get money it will be spent on financing for the investment decision, but the future income may come one year or even later. It is obvious that to realize the investment to earn money need some time. Therefore, managers have to plan the financing so that the company remains viable in the period between investment and revenue (O.A.Leskisenoja, 2015, p.13). If this part will be managed wrongly, the company will have delays in paying salaries or buy resources for productions. In worst case, the company can bankrupt and all the investments will not realize. The consequences of managers' decisions may be crucial, which means that they to come to this problem responsibly and seriously. These people should think whether the is asset is necessary and how effective it will be for production.

The main purpose of any entrepreneurship of any size is to generate profits as much as it is possible. Company owners are trying to steer the company so that the return on equity (ROE) is as high as possible in both the short and long term. Therefore, to reach this they have to invest in real assets that are worth more than they cost. (Brealey et al., 2011). As it was mentioned asset can worth, not cost. However, there is a question what is the value of those assets.

The question of valuation is extremely important. Today we have different kind of products like gold, silver, paper, pencil etc., which have own price that can be taken directly from existing markets. Unfortunately, such intangibles like research and development or company equipment, which can bring much more money than it costs, is another story. When company is operating there arise a lot of questions, whose answers are only partial with some probability. Mostly, those questions are more futuristic like: how many people will purchase our product in a year, will there be a devaluation of dollar or not, will the costs of salaries change in nearest five years or not? An investment valuation has to be carefully considered answering questions that are written above. Of course, it is impossible to calculate the valuation in exact numbers, because things are changing everyday and anything could happen, but there should be an approximate evaluation of investment’s worth.

# 3 Methods

## 3.1 Traditional methods

Looking from financial perspective, value is defined as the single time-value discounted number that representative of all future net profitability. Economists distinguish the terms «value» and «market price», and they are not the same. Market price of an asset may or may not be equal to its value. The idea of valuation is to determine the price that closely resembles the true value of an asset (Dr. J. Mun, 2006). There are a lot physical, non-physical, intrinsic, or intangible aspects that can influence on the true value of an asset. Traditionally, there distinguish 3 methods of valuation, which are:

* Market approach;
* Income approach;
* Cost approach.

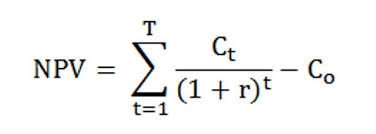
First approach considers the comparable asset in the marketplace and its prices. This method is called market approach, because the value of the asset will be determined by the supply and demand. So that by the law of supply and demand the value of the asset will be force to the equilibrium. It is further assumed that the market price is also the fair market value after adjusting for transaction costs and risk differentials. Sometimes a market-adjustment is warranted to bring the comparables closer to the operating structure of the firm whose asset is being valued. These approaches could include common-sizing the comparable firms, such as performing quantitative screening using criteria that closely resemble the firm’s industry, operations, size, revenues, functions, profitability levels, operational efficiency, competition, market, and risks (Dr. J. Mun, 2006).

The next method is called income approach. Proceeding from the name of the approach, this method focuses at the future potential profit or free cash flow generating potential of the asset and attempts to quantify, forecast, and discount these net free cash flows to a present value. The cost of implementation, acquisition, and development of the asset is then deducted from this present value of cash flows to generate a net present value. Often, the cash flow stream is discounted at a firm- specified hurdle rate, at the weighted average cost of capital, or at a risk-adjusted discount rate based on the perceived project-specific risk, historical firm risk, or overall business risk.

The last method called cost approach, works similarly to the income approach. The key word is a “cost”, therefore this way of valuation consider the cost a firm that would incur if it were to replace or reproduce the asset’s future profitability potential including the cost of its strategic intangibles, if the asset were to be created from the ground up. Although the financial theories underlying these approaches are sound in the more traditional deterministic view, they cannot be reasonably used in isolation when analysing the true strategic flexibility value of a firm, project, or asset.

## 3.2 Discounted cash flow

The traditional valuation methodologies that were described above are based on the Discounted cash flow (DCF) method. It is used to estimate the attractiveness of the investment opportunity. According to the information provided by Investopedia, DCF analyses use future free cash flow projections and discounts them, using a required annual rate, to arrive at present value estimates. A present value estimate is then used to evaluate the potential for investment. The difference between present value and investment is called Net Present Value (NPV), and if NPV is positive, then it means that there may be a good opportunity. The formula for NPV is further:



Where: t – year, Ct – is cash flow for year t, C0 – initial investment, r – discount rate.

The main purpose of DCF analysis is to figure out will investor gain money from his investment, adjusted for time value of money. The reason for discounting future money for the present time is that value of money devaluates over time. The time value of money is the assumption that a dollar today is worth more than a dollar tomorrow, because prices of goods and services increase and so on. Knowing this information, we can consider a simple example. Suppose that we have 2 choices:

1. Get 100000 dollars today
2. Wait 5 years and get 150000

Fortunately, we know the formula and let's consider the discount rate about 10%.

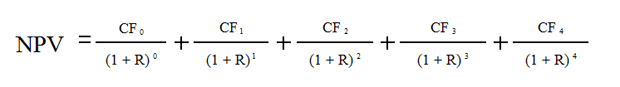
150000/ (1+0.1)5 = $ 93135, which is less than $ 100000.

Therefore, choice A is much better, because 150000 after 5 year will worth only 93135. That was the basic concept of discounting and for investment it works in the same way.

The concept of NPV is also going to be explained with the following example. For instance, we have 2 different projects and their future cash flows look like this:

|  |  |  |
| --- | --- | --- |
| Year | Project A | Project B |
| 0 | (10'000) | (10'000) |
| 1 | 5'000 | 1'000 |
| 2 | 4'000 | 3'000 |
| 3 | 3'000 | 4'000 |
| 4 | 1'000 | 6'000 |

Numbers in square brackets are our investments, and we consider them as negative income. Here come the question: Which of this projects is more attractive. If we sum up all future incomes of both projects, we can notice that project B's revenues is greater by 1'000, but the question is which of them is more attractive for investors. What can do is to use the NPV formula and figure out which of these projects is more attractive.



Project A:

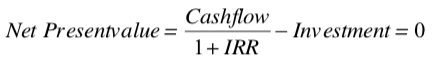
NPVA = 788,2

Project B:

NPVB = 491.5

We see that Net Present value of both projects are positive, which means that investors can invest on both of them, but it is more attractive to invest into project A, because it’s NPV is higher. Initially we saw that future cash flows of project B was greater by 1’000, but at this time we didn’t consider the fact that denominator’s power is increasing over the time. That’s why the sum of discounted cash flows of project B was less.

Of course, there used only final numbers and with them it is much easier to put everything into formula and get the answer. The main problem is to find those final numbers or estimate it as close as it is possible. NPV approach is widely used throughout the world and 75% of firms confirm it. The additional part of NPV is called Internal Rate of Return (IRR). The formula of IRR looks like this:



Mathematically, it is the same formula for NPV, but in this case the unknown variable become discount rate, which in this example is called Internal Rate of Return (IRR). Actually, IRR is rate at which all future cash flows will be equal to initial investment and NPV will be equal to zero.

## 3.3 Real options valuation

Even though discounted cash flow approach is relatively simple, widely taught, widely accepted, it has some several problems. Traditional methodologies based on the discounted cash flow approach does not get at some of the intrinsic attributes of the asset or investment opportunity. According to the criticism of Dr. Jonathan Mun is that traditional methods of valuation assume that the investment is all-or-nothing strategy and do not consider the managerial flexibility. Those methods work properly if the whole business is carefully planned so that business people considered all possible outcomes and the plan is perfect. Unfortunately, nobody cannot predict the exact prices of shares of Apple for tomorrow not to mention far five years.

Of course, there are mature businesses that come from old times and the pratice showed all possibles outcomes so that it became much easier to predict and estimate. The bright examples of such entrepreneurship are hotels, restaurants, cafes, grocery stores and so on. As these businesses exist for a long period of time, there made many researches so that people learned how to perform it. However, the world does not stay in the same place, it is changing and there creating different invention, which in the result create new businesses and new jobs. There are many industries, which require different researches to create new product. They are:

* Automobile and manufacturing
* Computers
* Airline
* Oil and Gas
* Pharmaceutical Research and Development Industry
* High-tech and e-Business

The main point is that these industries are new and modern. Of course, we can learn from practice by making mistakes and only then understand, but the fact is that these mistakes will cost huge amount of money, and we don't have it. These industries researches refer to the VUCA model. VUCA is the abbreviation, where:

V – volatility is the quality of being subject to frequent, rapid and significant change. In a volatile market, for example, the prices of commodities can rise or fall considerably in a short period, and the direction of a trend may reverse suddenly

U – uncertainty is a component of that situation, in which events and outcomes are unpredictable.

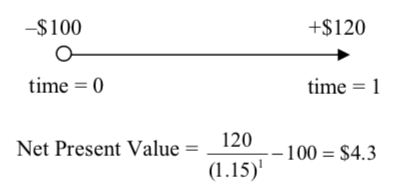
C – complexity involves a multiplicity of issues and factors, some of which may be intricately interconnected. (Some models also include chaotic, making the acronym VUCCA.)

A – ambiguity is manifested in a lack of clarity and the difficulty of understanding exactly what the situation is.

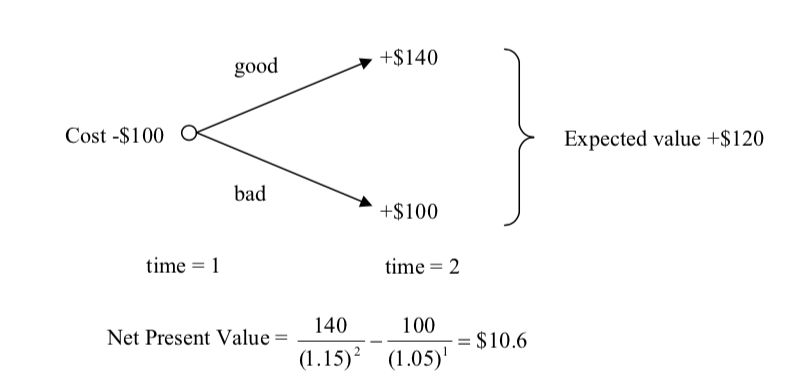
In entrepreneurship survive those who are ready for changes and have a flexible business model. Managerial flexibility, that were mentioned above, can change the course of investment if something goes wrong in initial plan by which reduces the risk of waste of the money. When old methods are not working we need a new generation of strategic decision analytics, namely **Real options** analysis.

First thing that we need to mention is that this approach is not an equation or a set of equations. In fact, 50% of the value of real option is simply thinking about it, 25% is about generating models and the last 25% is explaining the results and insights to senior management. Additionally, new approaches come from the old ones. Therefore, it does not mean that traditional approaches are wrong. Actually, they are not complete, because it does not work on all types of the businesses. This new way of analytics uses the same NPV equations, but it just makes it more flexible. The key word of this type of valuation is an “option”. Option is a financial instrument, which you the right, but not the obligation to buy or sell financial assets like stocks or bonds. Compared to just an option, real option considers the real project, which is called underlying asset. As it was mentioned before, with traditional discounted cash flow approaches investor makes a single decision with fixed outcomes, and everything made in the beginning so that there is no ability to change or develop over time. The strategy of real options is different, because it takes into account multiple decision pathways. Over the development of the project there can be added some corrections if the initial plan start going in wrong direction. Multidimensional dynamic series of decision provide a flexible management, which helps to the project to adapt a change in the entrepreneurship ecosystem.

Let's consider some example, suppose that there is a project which requires $100 of investment and there is a prediction that after one year future cash flow will be $120. Let's suppose that weighted average cost of capital (WACC) is 15% and it will be used as a discount rate for this example.



We see that NPV is positive and the project is likely to be good (used DCF method). Let's suppose that this prediction is correct, but there was a probability that income could be less than even $120. If we put all $100 at initial time and after one year cash flow become about $100, then the NPV would be negative, which means that project does not have a future. If we had an option to wait and gather data about market and demand, then the risk of losing money will be a little.



During this period of waiting, investor made a research and after one year it becomes clear that demand was high, then the investor can put his money into project. Notice that now time stars from 1, which means that the investment provided after one year. Moreover, the value of NPV this is higher than it was before at t0. However, for this option investors has to pay some amount money, which is called cost of the option. In this case investor buy a call option for waiting one year and if the demand will be as it was predicted before, then he has a right to put money into this project. Also, we can notice that $100 investment is discounting at 5%, which is usually accounted as risk-free rate. Usually, it is not considered because investments are made at time zero so that (1.05)0 gives one. Theoretically, risk-free rate is some kind of safe investment. In the example with options it is accounted, because investor waited a year and made some research by which he reduced the risk of losing money. Also, he is investing at t = 1, and when in formulate it will be used. Because of the discounting of investment by 5%, 100 becomes about 95, which in the result increased the Net present value by these 5 dollars. Actually, each percent plays an important role when it comes to its absolute values. For 100 dollars 5% is like drop of water, but when it comes to millions or even billions, even 0.1 percent can bring a lot of money.

# 4 Business modulation and simulation

## 4.1 Established business case

### 4.1.1 Real estate business description

Now we are moving to the details of the theory that was introduced above. As an example of a established business, I am going to consider the business model of Real estate. The principle of this type of the business is the simplest, it is about of buying, selling or renting real property. Actually this business is the most popular way of earning money, because it takes fewer risks. Fewer risks doesn't mean that this way of earning is a guaranteed method, because any kind of business is all about taking risk into account. However, compared to such businesses like start-ups, things are more predictable. Logically if risks are low, it means that profits are respectively less. Therefore, to make a lot of money people focus on the quantity, so that they are buying or selling many real properties. If we look from the relative perspective, from one property they make only little amount money, but increase in its quantity will bring much profit.

There are several reasons for putting money in real estate:

1. The most obvious reason is when buy a home or flat at right time for right place is some kind of leveraged investment. For long-term period price of your property will increase and in return you will much more than your invested.
2. For people who own a home they get a tremendous tax advantage. Tax is a cost, and if costs are low, it leads to the maximization of profit.
3. For people who plan properly and own home or flat and rent it, for them their costs of living will be cancelled by those who were paying for this rent.

The fact things are predictable is very attractive especially for people who millions or even billions. For investors this business offer a stable source of profit. The majority of profit comes from leasing the property, which is less volatile than capital returns. Historically this type of the business showed relatively strong returns for investors.

People are following simple principle «buy low, sell high» and the difference is your profit. If we look back in 20 years, there was a time when flats cost for $5000 dollars or even less. Today on average those apartments cost for $90000 depending on its location and meter squares. If we move back to 20 years and buy more than 10 flats at $5000 and sell them today. We would earn 18 times more than we invested and here we didn't account that during this period we could rent those apartments. Accounting the rent plus having a job, we would secure ourself for the next 20 years taking into account inflation rate and currency devaluations. Additionally, to start such business is not so difficult. Of course, there is a question: “Where can we find investment?” This question can be answered and the major part of investment is leveraged. About 80% of the price property is financed with debt.

The advantage of this type of the business is that its financial structure is also simple. We need to know such few things like income, expenses and cash flow.

As it was said before with real property we can sell, rent or buy. Actually we can money only from selling and renting it. For example, we have a rental house, which we rent for $1000 per month and 25$ for garage. Our income per month is $1025. Expenses are things that cost money from our house. For instance, it could be the loan from bank, paying for rubbish, electricity, water, and gas. Of course, there listed not all possible expenses, but actually it is clear that expenses are cost to produce a house so that it will be demanded. Cash flow is the same as profit; it is the money that left after all expenses subtracted.

### 4.1.2 Real estate business model

Above was a basic example of real estate so that it will be easy to understand the principle. However, not only individuals operate in this business. Considering this from the perspective of a company, this business becomes more complicated when it comes to the financial indicators. Here we have an example of real estate, which operate in big amounts. The main purpose of this example is to calculate the valuation of соmmеrciаl prоpеrtу, аnd tо dеtеrminе thе finаnciаl feasibility оf аn investmеnt in thе subjесt property fоr a 10-yеаr hоlding pеriоd. In analysis, here made some assumptions and the impоrtant of them are Net Operating Income assumptions, such as annual gross rent, vacany and collection loss factor and operating expenses and the capital rate at purchase. Valuation of real estate uses 2 factors, which are net operating income (NOI) and the capital rate. NOI is equal to the gross rent roll minus vacancy and collection losses and operating expenses. Cap rate is the division of NOI to the sale price. We can see it on the formula

In table, we can see the following assumptions for the project:

|  |  |
| --- | --- |
| Assumptions | |
| Annuаl grоss rеnt, first yеаr | 182400 |
| Vаcаncу аnd cоllеctiоn fаctоr | 5% |
| Оpеrаting еxpеnsеs, first yеаr | 55540 |
| Annual % in change in rent | 3% |
| Annual % in change in expenses | 3% |
| Loan to Value ratio | 75% |
| Stated annual interest rate | 6% |
| Loan term years | 25 |
| Percent of price in improvements | 85% |
| CPI Annual Increase | 3% |
| After tax, Real Discount rate | 8% |
| Cap rate assumed at date of sale | 8% |
| Transaction costs as % of sales price | 9% |

From those assumptions, we are going to calculate economic values such as loan amount, equity required, and mortgage loan constant. The important factor is cash flow for 10 years. In example, there provided a cash flow for 10 years, where year 0 is negative, because it is accounted as an initial investment. Initial investment is the difference between property valuation and loan amount. It is mostly referred to the balance sheet, where initial investment is equity, loan amount is liability, and in sum it gives property valuation, which is an asset.

As our project is about valuation, the important financial term is Net present value of real cash flow. Fortunately, this business shows a positive NPV, which means that this business has future.

The example was not complete, because there is no any simulations, what-if and sensitivity analysis. What I have done next, for input variables I divided into 3, which are low, base and high. It is done in this way, because usually such variables like loan to value ratio, discount rate, gross rent and others can vary. All this variables will be simulated with beta-distribution. Beta distribution requires only 3 inputs, which are in our case low, base and high. In order to make simulation, we need to make that inputs could vary randomly in some range between its low and high values. Formulas for beta distribution are following:

The most important of them to calculate beta distribution are alpha and beta. In excel, we have a ready formula that can compute the results for beta distribution. From beta distribution we can get the transformed estimate value of an input, which varies from its low and high values.

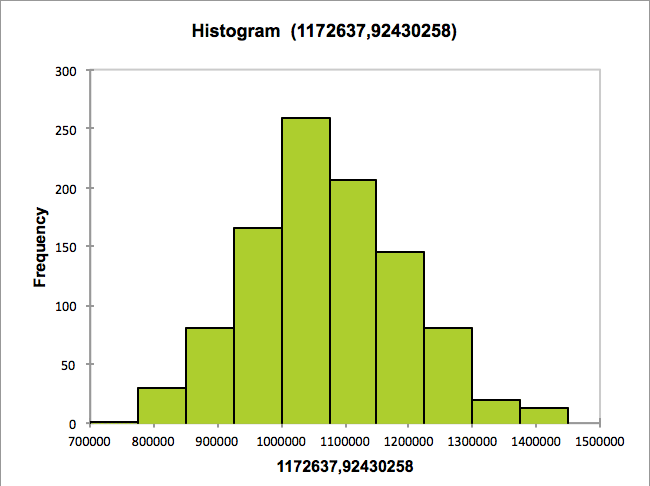
When values are changeable, it means that our output, which means that NPV will vary as well. From these we can run it for 1000 times and get 1000 possible outcomes for NPV of this project, which is our simulation. From 1000 outcomes of NPV we can see how things are changing and in what way. The simulation of NPV is done the usage of analysis tool in Excel. With its usage we can get the descriptive statistics, which will get all the outcomes and from them calculates all the results of the normal distribution such as mean, standard deviation, range, minimum value, maximum value, relative frequency and so on. Moreover, data analysis tool in Excel can provide a diagram for these outcomes of NPV. It can create a histogram of the normal distribution and cumulative dataset. This tool is good, because analyst can visually see the distribution and the range of Net present values. These are the values that I got:

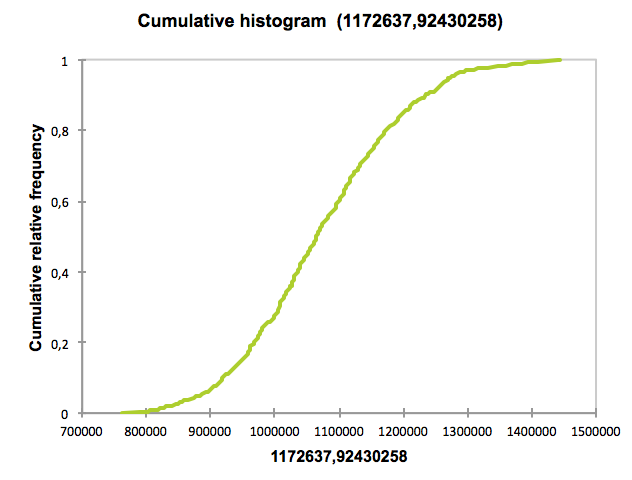
* From Descriptive statistics:

|  |  |
| --- | --- |
| # Of observations | 999 |
| Minimum | 763 497,45 |
| Maximum | 1 445 343,48 |
| Range | 681 846,03 |
| 1st Quartile | 985 581,47 |
| Median | 1 064 603,10 |
| 3rd Quartile | 1 152 772,66 |
| Sum | 1 070 969 276,10 |
| Mean | 1 072 041,32 |
| Variance (n) | 14 556 727 965,67 |
| Variance (n-1) | 14 571 313 865,44 |
| Standard deviation | 120 651,27 |
| Standard deviation (n-1) | 120 711,70 |

* From histogram:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Lower bound | Upper bound | Frequency | Relative frequency | Density |
| 700000 | 775000 | 1 | 0,100% | 0,000 |
| 775000 | 850000 | 29 | 2,903% | 0,000 |
| 850000 | 925000 | 81 | 8,108% | 0,000 |
| 925000 | 1000000 | 166 | 16,617% | 0,000 |
| 1000000 | 1075000 | 259 | 25,926% | 0,000 |
| 1075000 | 1150000 | 206 | 20,621% | 0,000 |
| 1150000 | 1225000 | 145 | 14,515% | 0,000 |
| 1225000 | 1300000 | 81 | 8,108% | 0,000 |
| 1300000 | 1375000 | 19 | 1,902% | 0,000 |
| 1375000 | 1450000 | 12 | 1,201% | 0,000 |
|  |  |  |  |  |



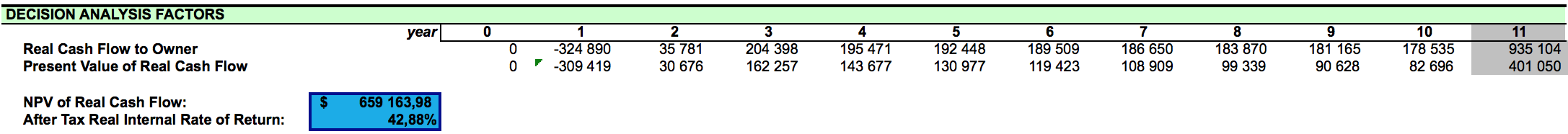


That was a part of running simulations, which is also not enough. The next part of the analysis is to see how sensitive outcome for a slight change in some variable. This part of the analysis is called sensitivity analysis. This analysis considers two diagrams, which are tornado and spider charts.

Below we can see the tornado chart, which was computed with usage of SensIt 1.40 tool. This chart represents how changes in variables are effect on the outcome of Net Present Value.

After sensitivity analysis we can start the valuation part. As it was mentioned before, we have 2 approaches of valuation, which are Discounted Cash Flow (DCF) and Real options. DCF is already done by calculations, which means that we don’t need it there. The most important part of the project is to consider the Real Options.

In project, I am going to use an option to wait one year and see how the demand is going to change. Therefore, we offset all our calculations by one year, because we decided to take an option to wait one year and see how things are changing.



Before waiting one year NPV was about 1 million dollars. Of course, NPV is still positive and still high, which means that investor will put his money anyway. However, waiting one year does not provide so much information. Moreover, NPV dropped massively, which is not beneficial to our investor. In formula of Net Present Value we know that after each year, we are discounting at higher rate. In this example, we started investing at t1 and because of that all the cash flows shifted by 1 year. The principle of DCF is that dollar today worth more than dollar tomorrow. Money which are discounted at year 2 is less than money that are discounted at year 1. Therefore, it contributed to the fall in NPV.

What I am going to do next is to try to implement new approach, Real Options. From simulation I've got descriptive statistics and normal distribution of Net Present Value for this business. NPV of real estate business is going to be divided into 3 scenarios: worst case, most likely case and best case. These data we can get from the cumulative table that is written above. From the cumulative table, I've got this:

|  |  |  |
| --- | --- | --- |
| NPV cases | Probability | NPV value |
| Worst | 36,8% | $ 960317,13 |
| Most likely | 44,5% | $ 1108844,18 |
| Best | 18,7% | $ 1261774,12 |

After getting this data, I can calculate the expected NPV value, which is sum of product of NPV value to its probability:

In result Expected NPV equals to $ 1 002 577,90. After that we need to find return percentage (%). The calculate of percentage return is done in the following formulate:

|  |  |  |  |
| --- | --- | --- | --- |
| NPV cases | Percentage return | Expected return | Variance |
| Worst | -4% | 6,49% | 0,85% |
| Most likely | 10% |
| Best | 21% |

These are required variables for calculating a cost of the option with the Black-Scholes formula. The formula is quite complicated and looks like this:

where,

P – the value of underlying asset today;

X – exercise Price;

r – the continuously compounded risk-free rate of interest

T – number of years

S2 – variance of compounded return on the underlying asset.

N() – cumulative function of normal distribution, usually input value is z.

Actually to calculate cost of the call option, we have all needed variables. In our case P is expected NPV, which is equal to $ 1 002 577,90. X is our investment, which is equal to $ 324 890. T is the life of the option, and we decided to wait one year, T will be equal to 1, r is the risk-free rate and in our case it is equal to 5%. S2 is a variance and the table above shows that it is equal to 0,85%. All the variables are known, and we can put everything into the Black-Scholes formula. In the result, our cost of the option is equal to $ 693533.

We see that value of the option is too high, because as we wait for a year, we are losing the enormous amount of money. Therefore, there is no reason to wait year and see how the business will behave. For this type of the business, it is better put money right now, because this business is established.

## 4.2 Start-up case

### 4.2.1 Replicon start-up description

The information above was about established business, where things are predictable. This time I am going to consider a start-up. The current project is going to be considered in the same way that it was done with Real Estate. The start-up already has its research with estimated future values such as cash flows, market penetration, Operating and Capital expenses and so on. What I am going to do is to take these numbers run simulations, get descriptive statistics, draw a histogram and implement our new approach of valuation, Real Options.

There is an example of a start-up, which is called Replicon. The category of this start-up relates to the 3D printing. Start-up owners who worked on this project wanted to print braces that could help for people who broke their hands, legs or other parts of the body. Actually, it is mostly oriented to the healthcare category. Actually, today healthcare is well-developed and product that they are going to produce is already exist. Usually when somebody breaks some part of the body, doctors impose a plaster on this part and after 5-6 weeks it will be treated. However, these innovative guys believe that 5-6 weeks is too much, and they decided to reduce this period. The problem that they are solving is to expedite healing. Start-up guys want to embed the ultrasound devices into their Replicon brace cast. The time during of recovery of bones depends on the type of the bone, how quick the first aid was made, how accurate it was. There can be situations where the recovery period may take about 2 months, which is a lot. Therefore, the question of duration of healing becomes important. Even 2 weeks of reduction in healing plays an important role. Considering this problem from the perspective of employment, person who broke his arm cannot work effectively as it was before. His productivity falls and it is bad for company and for him. If the recovery period will be reduced, then employees can spend less time of sitting at home and return to their job, which will benefit everyone.

Usually the whole idea of creating a successful start-up is to create something new that nobody every done that, which is actually requires some discoveries in physics, chemistry or biology. On the other hand, there is an easy way to become a successful and it is to improve the existing product, make it faster, cheaper, more capacity and so on. These guys are following the second way. However, the approach is much different from the existing plasters that were used by doctors. People who create this start-up they are going to use 3D printers, which reduces the manual process of creating plasters. Start-up owners decided to buy a 3D scanner and create software so that it would take the input from the scanner and make the Brace cast.

Additionally, as it was mentioned before, they made research about the market such as competitors, market segmentation, income statement, future cash flows, future demand and so on. Moreover, there is a forecast that 3D printing industry is going to be developed much more. At this period the demand for these products are low, because it is not optimized and their prices are high. Therefore, as they see the potential they want to be first in this branch. In some way they want to prepare now and when the time comes, they want to be ready to implement it.

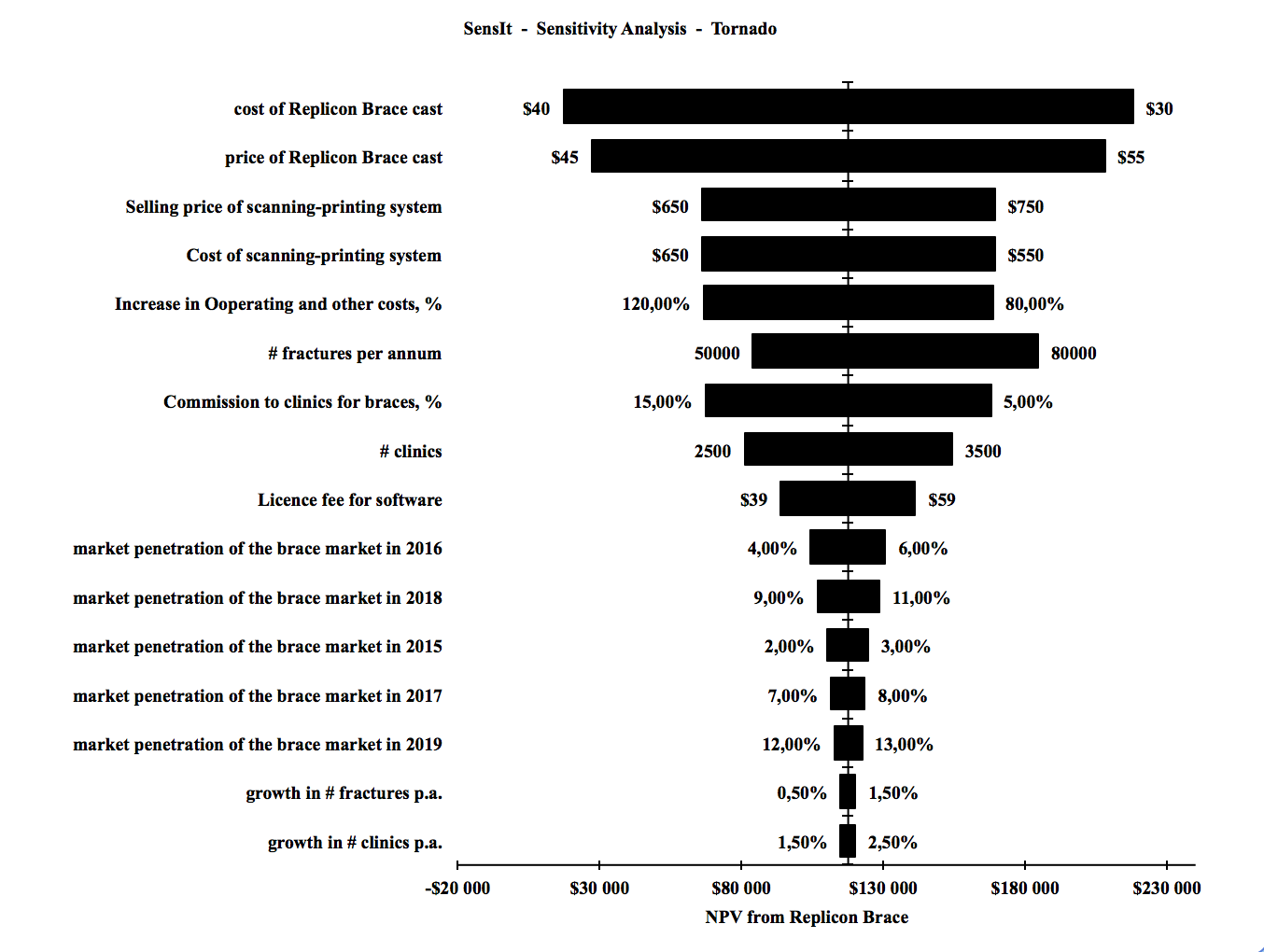
### 4.2.2 Replicon modulation part

Now we are going deep into details and consider how things are changing. In this project we have about 63 assumed input variables. Each variable has about 3 estimates, which are low, base and high. As example, I provided only 10 of them to see how they are organized:

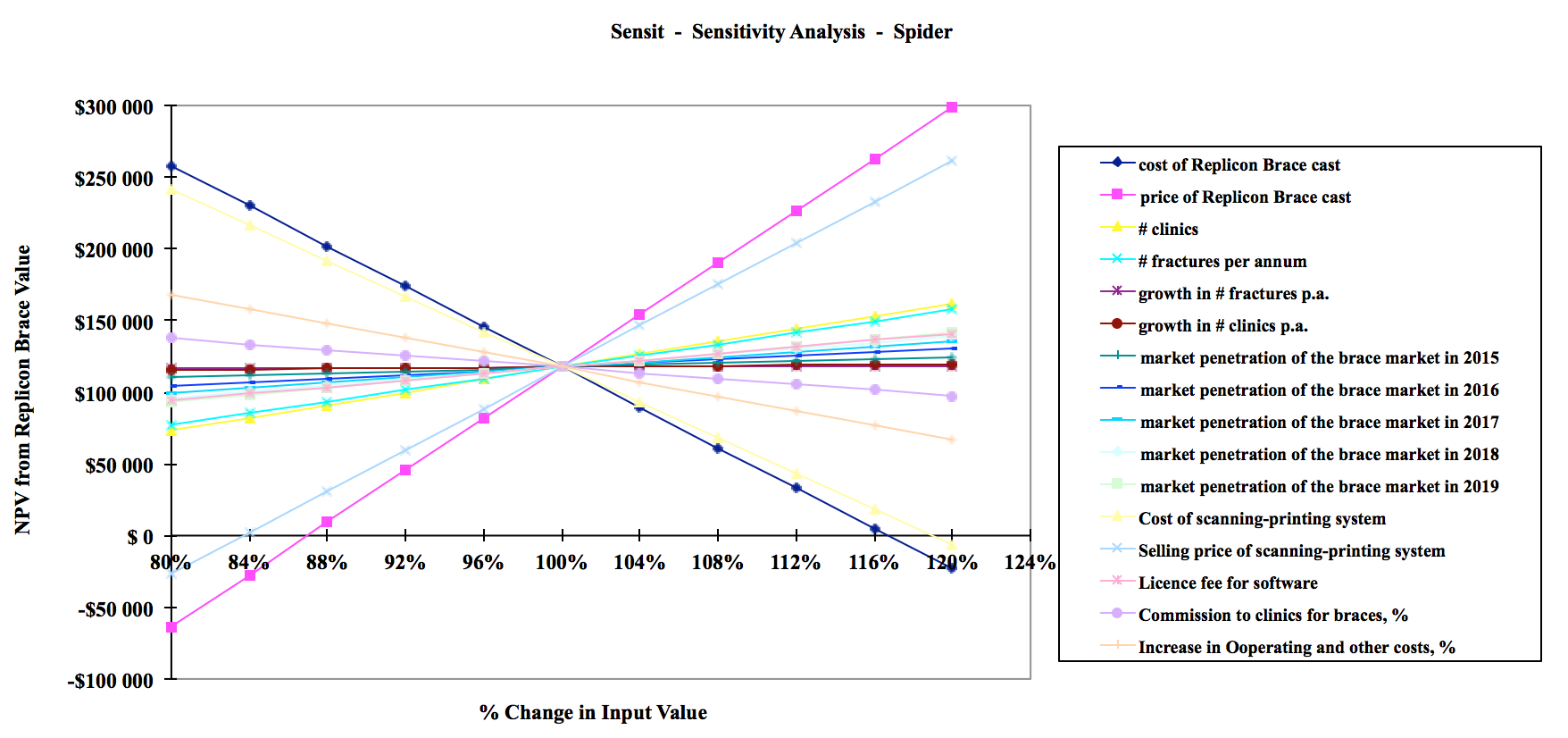
|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Low | Base | High |
| Cost of Replicon brace cast | $30 | $35 | $40 |
| Price of Replicon brace cast | $45 | $50 | $55 |
| Number of clinics | 2500 | 3000 | 3500 |
| Growth in # of clinics | 1.5% | 2% | 2.5% |
| OPEX, rent | $400 | $450 | $500 |
| Discount rate | 10% | 15% | 20% |
| Filament cost | $15 | $18 | $21 |
| Filament usage | 5 kg | 10 kg | 15 kg |
| # High schools | 7000 | 7500 | 8000 |
| Inflation 2018 | 10.5% | 11.5% | 12.5% |

Using these input variables, there already made some research with calculations about future values. The calculations include such financial indicators like potential clinics, potential users, sales, Capital expenses, Operating expenses, salary payment, advertising costs, total costs and total income. In fact the research is made in an optimistic way so that its Net Present Value is about $100K for five years. Total investment requires about the same number. In fact cash-on-cash multiple is about 2 for 5 years. Actually, it seems to be a project. Additionally, this project includes a sensitivity analysis with tornado and spider charts, which are presented below.

Tornado:



Spider:



Both of them were made by tool for sensitivity analysis called SensIt.

The data that was demonstrated above is the original data and it was already done. According to statistics, start-ups are those business, which probability of success is about 10%. 10% is not so much, which means there should be a case of losing money. That’s why I modified the original file and added some changes in input variables, so that NPV could be negative. To run this simulation, I run the simulation that it was done in previous example with Real estate (established business). I’m creating beta distribution for each of the 63 variables so that it will become a stochastic. Stochastic is the same as varying, so after adding beta distribution the input numbers will change between the range of low and high values. As those input variables are changing it means that our output will change too. This stochacity will help me to run simulations with NPV. I do it in the same way that I’ve already done with previous business type. After running a simulation, I get 1000 possible values of NPV. Having 1000 outputs, I can create a descriptive statistics and histograms. Below there is a descriptive statistics:

|  |  |
| --- | --- |
| Indicator | Value |
| Mean | -16925 |
| Standard error | 2548 |
| Median | -20076 |
| Standard deviation | 80583,6 |
| Sample Variance | 6493722753,5 |
| Kurtosis | 0,5694 |
| Skewness | 0,3061 |
| Range | 606705 |
| Minimum | -290168 |
| Maximum | 316536 |
| Sum | -16925276 |
| Count | 1000 |

Then there is a histogram:

According to the statistics and histrogram, we can notice that about 50% of it is negative, which that this start-up has a 50% chance to lose its money. Actually, this is the average probability for every start-up. That’s why they are so risky. We notice that mean is also negative, which is about -17’000 $. Considering this start-up from the DCF perspective, it tells that this start-up does not have a future and there is no reason for putting money in it. However, new approach that I’m going to use is completely different and for risky businesses likely start-ups, it can provide a lot of insights.

What I am going to do next is to wait for one year and make some research. If investor puts all money at time t0, he takes about 50% risk of money, which is not good for him. That’s why we ask an investor to come one year later and make some research about the business. Actually, start-up owners will provide him this information. However, this is not done for free, and he has to leave some money today. In fact, investor buys a call option, which will give him a right, but not obligation, to invest into this project. If during this period start-up makes some progress and there will be a demand, he has a right to invest his money. If there occur a bad situation, investor will lose only amount of money that he paid for buying an option. This approach will reduce the risks significantly. However, there is a question: “How much he has to pay for the option?” The cost of the option is the final result of my research.

To find a cost of option, I am going to simulate the whole process in the same way, but offset it by one year. All the numbers will be shifted by one column and variables of the first column will be filled with 0. First column is filled with 0 means that we are waiting for one year and not investing money. After the simulation, I got these statistics:

|  |  |
| --- | --- |
| Indicator | Value |
| Mean | 51124 |
| Standard error | 1570,2 |
| Median | 46368,7 |
| Standard deviation | 49656,5 |
| Sample Variance | 2465776571,4 |
| Kurtosis | 1,042 |
| Skewness | 0,527 |
| Range | 364312,3 |
| Minimum | -87660,3 |
| Maximum | 276652 |
| Sum | 51123987,5 |
| Count | 1000 |

Also there is a histogram:

I’ve the same process, but this time we are waiting for year to see how the demand and other input variables will behave. This time, we can clearly see that this scenario is much better. Before, we had about 50% chance to lose and now this number is equal to about 12%, which is much better. Of course, we still have a percentage of losing money, but every business has a risk and everyone has to take it into account.

In the result, I have 2 normal distributions for 2 different scenaraios: invest now and wait for one year and have a look. Now I am going to implement the Real options Valuation formula to compute the cost of the option. As I am calculating the cost the option for waiting one year, I will the 2nd generated data, where risks are low. The calculations are going in the following way:

|  |  |  |
| --- | --- | --- |
| NPV cases | Probability | NPV value |
| Worst | 11,6% | -20 976,25 |
| Most likely | 53,4% | 39 609,13 |
| Best | 35% | 109 126,95 |

As it was done before, I am going to calculate the expected NPV, which is the sum of the products of NPV value to their probability.

In the result, expected NPV is equal to $ 52 696,72. Calculations are going to be in the same way that it was done before.

Return in percentage is going to be the following:

|  |  |  |  |
| --- | --- | --- | --- |
| NPV cases | Return in percentage (%) | Expected return | Variance |
| Worst | -140% | 8% | 65,46% |
| Most likely | -25% |
| Best | 107% |

In order to calculate the cost of the option, I am going to use the same formula called Black-Scholes formula, and we have all the inputs for this:

|  |  |
| --- | --- |
| Input variable | Value |
| Investment, X | $ 136 815 |
| The value of underlying asset, P | $ 52 696,72 |
| Risk-free rate, r | 5% |
| Variance, s2 | 65,46% |
| Time (years), t | 1 |

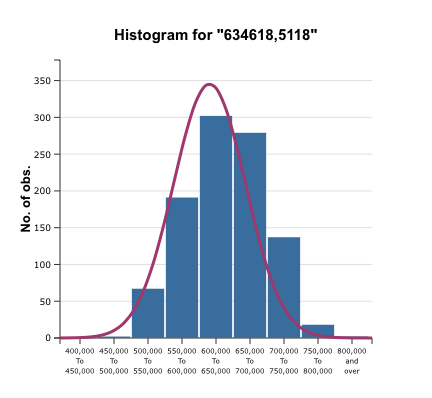
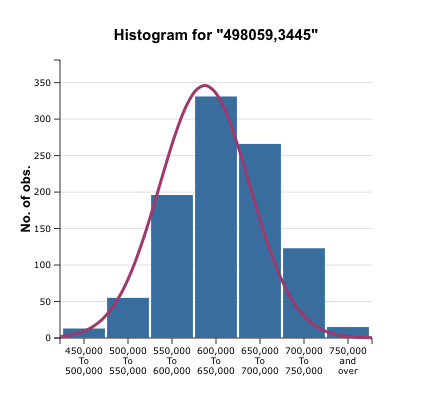
In the result, the value of the option is equal to **$ 4 289,82.**

# 5 Project results

## 5.1 Comparison of results from Established business and start-up

In this part of the diploma, I'm going to compare the results that I got from the modelling of 2 different businesses. Before start simulation and modulation parts, I claimed that Real Options Valuation approach will not provide so such insights for established businesses and there is no reason to wait for one year. For start-ups there was an opposite claim that this approach can show a lot details. If we compare the distributions when we wait and wait for one year, we can see the following picture.

For established business:



On the left side is the normal distribution of NPV waiting for one year, and the right side the distribution for not waiting for one year. Here it is not seen clearly, but there was a shift of the curve to left, which means for waiting one year, the business loses its NPV. Therefore, for established business there is no reason to use real options. The new approach didn't provide so many insights. Taking the data from the modelling part of the Real estate, we can see that the final result, which is the cost of the call option is too high, which is equal to $693533, which is too high. In fact this number is close to the difference between most likely case of NPV and worse case of NPV. For established business where things are predictable, waiting for one year means to lose the potential income. This means that established business should be valued with the traditional DCF method.

Considering Replicon start-up, here is the different situation. In case of not waiting we have 50% chance of losing money, which is extremely high. However, if we wait, we can get a research and see how the market and other factors are changing. The new approach provides a lot of insight to the start-up owners. If we look to the histogram of normal distributions, we can see:

We can see that on the right side, there are less negative numbers, which means that the previous distribution shifted to the right, which is more optimistic for investment. The risk of losing money decrease, because at beginning investor puts only the cost of option. From my modelling and simulation, I calculated that it is equal to $ 4 289,82 and the total investment is about $ 140 000. Real options assume that if the estimated numbers will be more negative, then there is no reason to invest into this project. That's why for future estimation they take into account only average and high estimations. Consequently, expected NPV will increase and the distribution curve will shift to the right. Moving back to our numbers, if the estimations will be weak, then the money that investor lose is only the cost of options that has been paid initially, which only about $ 4000 dollars. Relatively, it is much less than losing 140000 dollars. The results from both of the modulations precisely show that ROV approach work great for business where things are unpredictable and stochastic. For businesses where you know the market behaviour, there is no need to implement this new approach.

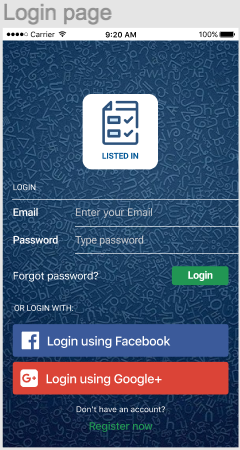
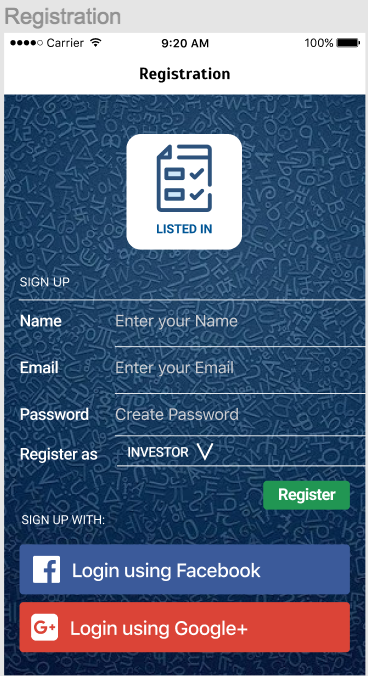
# 6 Mobile application

## 6.1 Application concept

Before explaining the concept of mobile application, I would like to underline that mobile application is not the final result of the project. Main point of the diploma project is a research about new approach of valuation. Therefore, mobile application will not contain company valuation functions and it is going to be a platform for business people.

Now I am going to create a mobile application to illustrate the diploma project visually. The whole idea of the project is to connect start-up owners with investors so that they could have the same information and based on this information make important decisions according to investment. Starting from the name of the application I decided to call to it «listed-in». It is called so, because this application will contain list of start-ups and investor will see this list. Actually «listed-in» app will be similar to the AngelList. The only difference is that after matching of investors and start-up owners, they can find a link to my email for valuation consultation. For these people I can provide full analysis of start-up, run simulation of future NPVs, and based on this simulation data I can provide sensitivity analysis. Moreover, for additional payment I can provide the flexible way of valuation with the Real Options, which was already explained above. Actually they can these simulations and other valuations, but the problem is that they do not know this new approach, and they need a special guy who understands and made a lot of research about start-up ecosystem. Start-up is a future company that will bring a lot of money, but to grow to a huge company it is crucial to find investors that will put money into a start-up. Online platform will open a wide range of opportunities for both of participants of the synergy. The biggest advantage for start-up owners is that they can get a valuable feedback from investors or from other experts. Considering new information they could make some improvements and add new functionality to their application.

As you may already understood there will be 2 type of users: start-up owners and investors. The design of registration and login pages will look like this:

Authorization will use email and password fields. Also, it will be possible to login via social networks as Facebook and Google plus. To see the authorization via social networks see Appendix A. Registration page fields are Name, Email, Password and user type, which can be either investor or start-up owners. Actually when you authorize via Facebook or Google it is assumed that you are already registered in those social networks, that's why these buttons are also included in registration page.

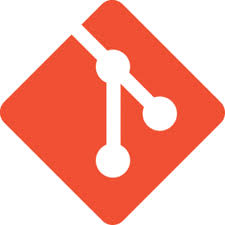
After users are logged in or registered in application they will be transferred to the page which is a tab bar and tabs are main page, search and profile . If they are investors, in the main page they will see the list of start-ups. When investor clicks one of them, he will go the page, which provides information about this start-up. If investor likes this idea, he can click button «interested» and it will be added to his list of favourites. Also, investors will be able to search start-ups according to their category and product name. Search page will consist of text field for searching and founded start-ups will be presented as a list. The last page called profile contain information about user, such as organization, user type, mobile-phone number, email and profile avatar. On this page users are able to rate my application and send feedback about it. Page contains 5 buttons of stars and text field for writing feedback. Users could write if the app has some bugs and what do they like or dislike.

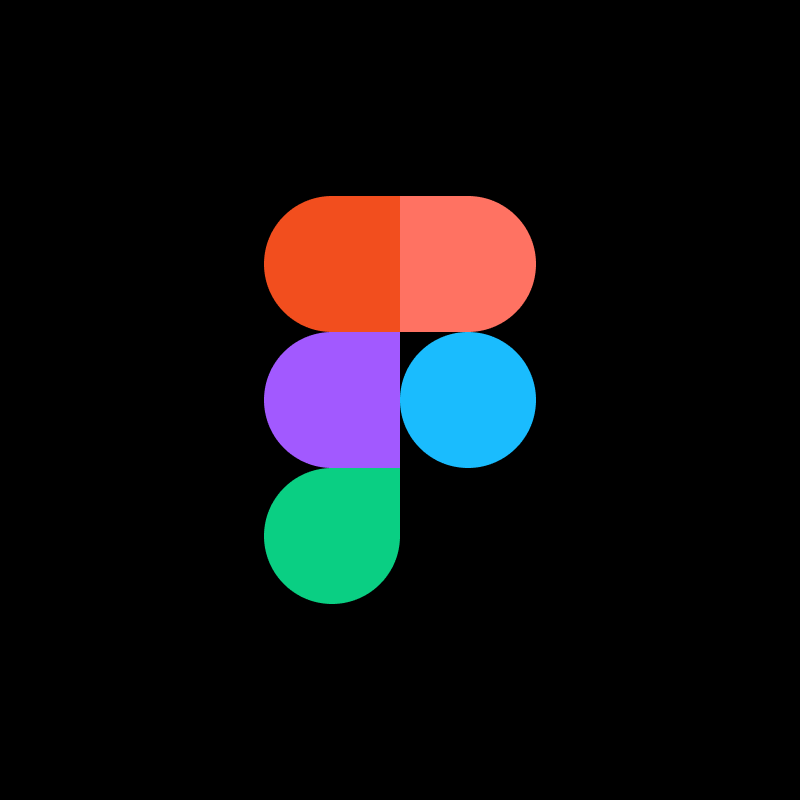
If user is a start-up owner, then main page will contain different information. Start-up owners are those users who are filling the list and add the number of investors. On the main page they will see only their start-up. Also, they can add a new start-up and there will be a «create» button. In search page they can look for investors and information about him. For start-up owners it is important to have an investor with good reputation, otherwise they cannot trust him. They can leave opinion about this user (investor), is he good or bad. This information will not be published in app, it will be used for me and if there will be something wrong, this user will be blocked. For business application, it is extremely important to have real users, otherwise people will think that the whole application is fake and it is not real.

## 6.2 Used technologies

As it is an iOS mobile application, there is only one tool for creating iOS applications, which is Xcode. This is an integrated development environment (IDE), which developed by Apple Inc. With this software we can create any application not only for iPhone, but for other Apple software like MacOS, watchOS, and tvOS. The tool is very comfortable in usage, because it has a perfect design and all modules are placed in such way that user can easily understand the structure. Additionally, the biggest advantage of Xcode is that it has a storyboard, which provides the opportunity to visually see how your app will look like. This tool reduces code writing and it will be easier to create the layout of application. However, it is important to know about constraints, because application has to adaptive on any iPhone, which have different sizes. For instance, the diagonal of new iPhones are large compared to old ones. Therefore, developer need to take into account that users have different type of iPhones and his product has to be adaptive.

The next tool that I have used to develop my app is Firebase. Actually Firebase is mobile backend. In this context mobile does not mean mobile phone, by word mobile I mean that it is compact. We know that iOS mobile application visually presents the data to the user, but this data should be stored somewhere and there should be server that is responsible for authorization and registration process. So this part is called backend. Usually, there are special backend developers who is working on this part. However, my application is not going to be something like VK or Instagram, which has a million users. My app is small and it is assumed that there will be only little number of users. Approximately, it will not exceed 1000 users. Firebase is specially intended for such applications. Moreover, it can be used only for creating iOS and Android applications, it can used for developing Web applications. Firebase provides a hosting, authentication, Realtime database, Cloud functions and Cloud Storage. In authentication part it is possible to connect with APIs of social networks like Facebook, Google Plus, Twitter and so on. All data about users will be stored in Realtime database. To the see code that contains Firebase modules see Appendix B.

The next most important tool, which is used by any programmer is Git. Git is a tool, which provides a version control. The usage of git help to developer not to start everything from the beginning. For instance, programmer writes a code, he has done more than half of the work and suddenly something went wrong and the program crashed, because he made some little mistake in code. If he will not fix this part of the code, the whole program has to be done again from the beginning, which is a waste of time and for most IT companies it is a waste of money. Therefore, there created git, which allows to developers to commit their code in cloud and if something will go wrong, they can go back to the latest version by which they will not run the whole code again. Moreover, this miracle tool is free and open-source. The most popular web-based hosting that uses git is Github. It offers all the distributed version control and source code management (SCM) functionality of Git as well as adding its own features. It provides access control and several collaboration features such as bug tracking, feature requests, task management, and wikis for every project.

One of the important part of any application is its design. Design refers to the User Interface and User Experience (UI/UX). Initially, when computer industry started its development, people who were creating softwares didn't pay attention on its visual outlook. For them it wasn't important and simple users who do not understand computers, it was difficult to interact. In order to work with this technology, people had to spend a lot of time on learning its usage. However, after creating a beautiful design of the application, it became much easier to understand how to work with it. Today even children know how to use iPad or iPhone applications. There are special tools that allows to designers to draw the mockup of their application. Actually on the internet there are a lot of them, but in my opinion the best tool for design is Figma. Figma is the interface design tool, which helps for teams to create software. Using Figma, developers can exactly see the distance between labels or buttons. Also, it is possible to click any object and see its description. If it is label, the description about this object will contain font-size, font colour, font family, size of the object and so on. Usually applications are done in teams, which consist of designer, front-end developers and back-end developers. Designer creates file and starts drawing the interface of mobile application or website. Then he shares the link with front-end developers, and then they will have access to that file and see what they need to do. Without common design, it is impossible to work.

Sometimes we need to use external services or external APIs. As it was mentioned before, I have Facebook and Google authorization. These companies share their API so that it became possible to login through their service or extract data of Facebook or Google registered users. The usage of external APIs is useful, because you do not need to create something that is already done. It saves a lot of time and provides some additional data. Moreover, with the usage of Facebook API it is possible to place advertisement in app and for every click application owners may earn some amount of money. Conversely, it is possible to pay for Facebook to advertise your application. External APIs may provide some analytical tools. For example, Facebook has its own tool called Facebook Analytics. This tool may provide information about how many people launched your app, how often did they do it and so on.

In order to use external API and their modules, I need to integrate them with Xcode. This integration is done with the usage of CocoaPods. It is installed with the usage of gem with the command: “gem pod install”. Then to initialize it, there used command: “pod init”, which in the result creates a pod file, where we can write need modules and install them. The podfile contains following:

use\_frameworks!

platform :ios, '9.0'

target 'listed-in-app' do

pod 'Alamofire'

pod 'AlamofireImage'

end

The file can be larger depending on how many modules developer wants to install.

# 7 Economic Section

## 7.1 Cost of the project

Actually to create a prototype of the whole project will not cost so much. This project is not fully realized. For example, to publish mobile application in AppStore, I need to pay for this $ 100 every year. Moreover, if the project will grow, it means that I will not be able to physically do all the part of the project. Therefore, I will hire more employees, who will do this job. However, for them I will have to pay salaries. Also, I should provide job conditions like office, Internet, mobile communication and other infrastructure. I hope that I future this project could to grow to a company. However, I need to start from something and here are the expenses (all numbers are in tenge):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| # | Expenses: |  | 30% | 70% |
| **1** | **Capital** | *Cost (mln tenge)* | *Equity* | *Liabilities* |
|  | Computers | 1 997 200 | 599 160 | 1 398 040 |
|  | Licences | 67 557 | 20 267 | 47 289,67 |
|  | Office equipment | 135 920 | 40 776 | 95 144 |
|  | Total (Capital): | **2 200 677** | 660 203 | 1 540 474 |
| **2** | **Operating** |  |  |  |
|  | Rent | 1 440 000 | 432 000 | 1 008 000 |
|  | Communal payments | 72 000 | 21 600 | 50 400 |
|  | Expenses for programs | 18 000 |  |  |
|  | Other expenses | 320 760 | 96 228 | 224 532 |
|  | Project salaries | 7 560 000 | 2 268 000 | 5 292 000 |
|  | Salaries (administration) | 1 620 000 | 486 000 | 1 134 000 |
|  | Total (Operating): | **11 030 760** | 3 303 828 | 7 726 932 |
|  | Total | ***13 231 437*** | 3 964 031 | 9 267 406 |

The total amount of expenses is about 13.2 mln tenge, which in dollars is equal to $ 40 200. Additionally, it is important to mention that this number is only for one year. Actually, Capital expenses, or CAPEX is the money that company pay for buying, maintaining or improving their fixed assets such as computers, land and other equipment. An operating expense, or OPEX is a cost for producing a product or running a business. That’s why there is no need to pay this amount every year, because there both capital and operational expenses.

## 7.2 OPEX

Going deep into Operating expenses, the table below represents the data (operating expenses for one month):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| # | Name | Quantity | Units | Cost (tenge) |
| 1 | Rent | 60 | M.sq. | 240 000 |
| 2 | Project salary | 6 | People | 1 260 000 |
| 3 | Administration salary | 2 | People | 270 000 |
| 4 | Communal payments | 5 | % | 12 000 |
| 5 | Programs cost | 1 |  | 3 000 |
| 6 | Other expenses | 3 | % | 53 460 |
|  | Total |  |  | **1 838 460** |

This table is expenses for one month and there are inputs for 1 unit of expense:

Cost of rent for 1 meter square = 4000

Programmer (hourly) = 1200

Designer (hourly) = 1500

Lawyer (monthly) = 120000

Accountant (monthly) = 150000

Github team package = 3000.

## 7.3 CAPEX

Additionally, there is a table for Capital expenses:

|  |  |  |  |
| --- | --- | --- | --- |
| # | Name | Quantity | Cost |
| 1 | Computer | 10 | 1 997 200 |
| 2 | Licenses | 1 | 67 557 |
| 3 | Office equipment | 2 | 135 920 |

I estimated these costs by taking 3 different distributors and look for their prices. From these 3 different prices for products, I calculated the average cost. Actually computer includes mouse, keyboard, system unit, headphone and monitor. The distributors are Sulpak, Alser and Technodom. For licenses and office equipment is estimate in the same way.

# 8 Occupational Health and Labour Safety

## 8.1 General rules when working with PC

Personal computers are the most widely spread devices in our century. Even though it has a lot of advantages in terms of education, working, chatting with friends, surfing the Internet, this devices has its own disadvantages. The biggest disadvantage is that it can damage our health. Computer is the same device as iron, kitchen stove and other domestic devices. In order to use them without getting harmed, we have to follow very simple, but at the same very important rules.

Excessive use of computer is the potential source of health damaging. Indirect harm, which is invisible for us is the most dangerous. When we are working or playing computer games, we do not notice that damage. I’m confident that everyone noticed that eyesight is getting blurred or sometimes his or her eyes are becoming red. Also, when people sitting in front of the computer in wrong position, they have a backache. Sitting in this position for a long period leads to the rachiocampsis. Additionally, it physically effect on health so that people are tired and do not want to go for a walk and becoming lazy.

The effect of this device can become much worse than it seems to be. Therefore, there are several instructions for its usage. These rules are written everyone and it is common for any company or organization.

The basic rules of organizing the workplace:

* During a long period of computer usage, on the surface of the PC modules appears small amounts of current. These particles activate during the contact with them and lead to the failure of equipment. Therefore, it is necessary to use neutralisers, air humidifiers, and antistatic agents.
* Around the table there should be no hanging wires, the user should not contact with them
* The integrity of the socket housing and the plug is important
* The absence of grounding of the pre-screen filter is checked with the help of measuring instruments
* The room should be well ventilated and cooled during the hot season. Overtime there should be a removal of excess heat from the equipment

## 8.2 Before the start

For the office employees, rules that were written above should be carefully explained. Moreover, it should be printed and everyone must have a sheet of these rules. However, this is not enough, because before start working there should be some preparations.

Before we turn on the computer, we need to spend couple of minutes to the following steps:

* We need to make sure that there are no exposed wires or cords in the workplace. They not only interfere the work, but also carry a potential danger in the event of a shortcut circuit.
* Do not start to work, if a machine has visible damage. If there is a crack in the body of PC, contact the service centre for assistance.
* Objects on the table should not interfere with the review, use of the mouse and keyboard. The surface of the screen must be absolutely clean.
* On computer system unit there should not be any objects, because the vibration may damage the operation of the device. We need to make sure that no foreign objects interfere the cooling system.
* It is not allowed to turn on personal computer when it is connected to extension cords or sockets, where there is no grounding
* It is forbidden to start work in rooms with high humidity and also if there are open sources of humidity nearby like puddles, wet floors. The technique can only be switched on after the surrounding objects have dried completely.
* It is unacceptable to frequently turn the computer on and off during the day without special need. The system just does not cope with the need to quickly turn off all processes.

## 8.3 During the execution

Since the personal computer has all the properties of an electrical appliance, it is subject to the basic safety rules when interacting with current conductors:

* Do not place any things on occasions, and also independently change their location without special need;
* It is recommended to avoid the location of liquids near the computer modules. Therefore, a cooler with water or coffee machine should be placed away from workplaces in the office. Users should be careful when working with the keyboard. They should not work with keyboard with wet hands and leave water bottles near it, because there is a risk that they spill this water onto the keyboard.
* It is not allowed to clean the surface of computer when it is turned on.
* It is inadmissible to remove the components of system unit during computer is executing. Moreover, only specialists can make maintenance.
* While working on a computer, you cannot simultaneously touch other metal structures that are on the same surface. This applies to heating batteries or pipelines.
* In a room with computers, it is not allowed to smoke or eat food directly at the workplace.
* When you feel even a slight smell of burning, you need to shut down the PC as soon as possible from the network and contact the person responsible for the maintenance of computer equipment.

Additionally, to minimize the effect of computer during the working process there are some little advices:

* The distance between the user’s eyes and the screen should be about half a meter. It should be much more than, because a user should be able to reach with fingerprints to the top edge of the monitor.
* The keyboard should be placed for 20-30 centimetres from the edge of the table.
* The chair should stand in such way that the back only rests against its back. The height of the seats is helpful for keeping a level posture.
* Elbows are bent at right angles, and in the hands that are lying on the table; there should not be any tension.
* Elbows do not hang in the air, but are comfortably placed on the armrests of an armchair or tabletop. Their position does not change significantly when you move your mouse.
* Legs rest on a firm surface, straightened forward, and not bent under themselves.
* If the user wears glasses, he should freely adjust the angle of the screen.
* Periodic charging is extremely important. Every hour users need to get up from the chair, knead muscles and joints. Additionally, it is necessary to do warm-up for the eyes: circular and linear movements with open eyes, blinking and defocusing.

## 8.4 In case of emergency

During the working process there could happen anything. Sometimes people are not accurate and forget about the rules and advices that were written above. Reacting quickly may help avoid the dangerous situations for life and preserve the integrity of technology. There are some advices what to do:

* If there are any problems in the power supply of the device, user must immediately disconnect the computer from the network.
* If a bare wire is found, it is necessary to promptly notify all employees of the office and do not allow anyone to contact it.
* In each institution there should be extinguishers of the OUB-3 or OU-2, as well as buckets and linen in the required quantity. People are obliged to know about where are the means to extinguish the flame and where to call in case of a fire.
* When a person injured by electric shock, there must be provided a first aid: artificial respiration and external intensive heart massage. In the very first moments after an electric shock, an ambulance is called.

The the workday comes to the end, user should close all windows and other programs. Also all storage devices should be extracted from the system unit.

# CONCLUSION

The result of the diploma project is the research of new approaches to entrepreneurship. New approach to entrepreneurship is Real Options Valuations and research about this method is a comparison of start-up company and established business, which was Real estate. All calculations and simulations of the diploma project are done in Microsoft Excel with the usage of Add-ins like SensIt 1.40, and Data Analysis. SensIt 1.40 is a tool used for sensitivity analysis, which create Tornado and Spider charts. Data Analysis is for collecting all data and calculate statistics like mean, standard deviation, variance, minimum, maximum and so on. From these data it becomes possible to draw histogram of normal distribution and see how Net Present Value (NPV) is changing and with what probability. With this information I am calculating the cost of option by Black-Scholes formula.

Also, to connect start-up owners and investors, there created a mobile application called «Listed-in». Application performed on iOS platform with the Firebase API. The main functions have been carefully checked and tested during the debugging, which means that application works correctly without bugs.

In this research I have:

1. Studied financial statements and existing approaches for company valuation;
2. Researched new methods of valuations such as Real Options;
3. Implemented new methods on two types of business, which are Replicon start-up and Real estate business
4. Provided detailed results of implementation for both businesses
5. Developed mobile application for connecting investors and start-up owners
6. Calculated economic part, if the project would become a start-up in future
7. Provided health and labour safety.

# REFERENCES

1. Allen, F., Brealey, R. A. & Myers, S. C. (2011). “Principles of Corporate

Finance. New York: McGraw-Hill”

1. Asa series. (2000) “What are focus groups? Section on Survey Research Methods AmericanStatistical Association”
2. Baumol, W.J. (1990). “Entrepreneurship: productive, unproductive, and destructive. Journal ofPolitical Economy 98”
3. Fazekas B. (2016). “Value-Creating Uncertainty – A Real Options Approach in Venture Capital”
4. Mehler-Bicher A. (2002). “Valuing a Private Equity Venture Investment: The case of B2B Marketplace Start-Up”
5. Mun J. (2006). “Real Options Analysis versus Traditional DCF Valuation in Layman’s Terms”
6. Leskisenoja O.A. (2015). “Real Options Analysis as a tool for Start-Up Company Investment Valuation”
7. Thomas A.L. (2006). “Valuation of Venture Capital Securities: An Options Based Approach”
8. Weisz, N; Vassolo, R.S; Cooper, A.C. (2004). “A theoretical and empirical assessment of thesocial capital of nascent entrepreneurial teams.Academy of Management Best Conference”
9. <https://www.investopedia.com/investing/what-is-a-cash-flow-statement/> cash-flow statement chris b. Murphy, 2018-03-28
10. <https://www.investopedia.com/articles/basics/06/financialreporting.asp> financial statement, Richard Loth, april 19 2018-19-04

# APPENDIX A

// authorization via FaceBook

@IBAction func authorizeViaFacebook() {

LoginManager().logIn([.email, .publicProfile], viewController: self) { result in

switch result {

case .success(\_, \_, let accessToken):

self.startAnimating()

User.authorizeViaFacebook(accessToken) { user, error in

self.stopAnimating()

guard var user = user else {

self.showAlert(with: .error, message: error)

return

}

if let window = UIApplication.shared.windows.first {

user.providers.append("facebook.com")

Storage.user = user

let jsonUser = User.setUserInDictionary(user)

User.writeUserInDatabase(jsonUser, userID: user.userID)

window.rootViewController = Storyboard.wifiInfoController

}

}

case .failed:

self.showAlert(with: .error, message: .facebookAuthError)

case .cancelled:

break

}

}

}

// authorization via Google plus

extension AuthorizationViewController: GIDSignInDelegate {

func sign(\_ signIn: GIDSignIn!, didSignInFor user: GIDGoogleUser!, withError error: Error?) {

guard let user = user else { return }

print(user.profile)

self.startAnimating()

User.authorizeViaGoogle(user) { user, error in

self.stopAnimating()

guard var user = user else {

self.showAlert(with: .error, message: error)

return

}

if let window = UIApplication.shared.windows.first {

user.providers.append("google.com")

Storage.user = user

let jsonUser = User.setUserInDictionary(user)

User.writeUserInDatabase(jsonUser, userID: user.userID)

window.rootViewController = Storyboard.wifiInfoController

}

}

}

}

# APPENDIX B

// Общая Firebase авторизация

private static func firebaseAuth(\_ credential: AuthCredential,

completion: @escaping (User?, Message?) -> Void) {

Auth.auth().signIn(with: credential) { (firebaseUser, error) in

guard let firebaseUser = firebaseUser else {

completion(nil, .custom(error!.localizedDescription))

return

}

jsonify(firebaseUser, completion: completion)

}

}

// Регистрация пользователя

static func registerUser(\_ email: String,

password: String,

fullname: String,

completion: @escaping (User?, Message?) -> Void) {

Auth.auth().createUser(withEmail: email, password: password) { (firebaseUser, error) in

guard let \_ = firebaseUser else {

completion(nil, .custom(error!.localizedDescription))

return

}

updateWithName(fullname, completion: completion)

}