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ANALYZING ACQUISITIONS IN THE VIDEO GAME INDUSTRY THROUGH A REAL OPTIONS LENSE

Examiners: Professor Mikael Collan
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ABSTRACT

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Analyzing Acquisitions in the Video Game Industry through a Real Options Lens

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This thesis represents an analysis of corporate acquisition in the video game industry through a real options lens. While the number of acquisitions in the industry is rising, merger and acquisitions in the video game industry are poorly covered by scientific literature. Thence, the aim of this thesis is to develop an algorithm for a pre-acquisition target company valuation for the video game industry.

Theories clarifying motivation of acquisition were examined for setting possible scenarios of acquisition. In order to elect the most optimal and accurate valuation method for the valuation tool two classifications of target company valuation methods were observed. As the result, the fuzzy pay-off distribution real option valuation model was selected to be used as it is able to treat uncertainty related to acquisition target screening.

To develop an algorithm that meets the video game industry features and dynamic nature, an overview of the video game development, industry trends, and significant cases of merger and acquisition were discussed. To develop in-depth understanding of video game industry several experts were interviewed with a semi-structured technique. Based on the interview results possible acquisition motives and potential real options were defined, and the valuation tool was designed.

The valuation of target company was recounted separately for target company as stand-alone and related to the target acquisition possible synergies. Also the impact of corporate culture was included in the valuation procedure. The use of the fuzzy pay-off method, multiple one-period discount rate, and dynamic inputs allowed to accurately valuate the target company. Finally, a numerical illustration for the described algorithm was presented to demonstrate its capacities and limitations.
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LIST OF SYMBOLS AND ABBREVIATIONS
ARPDAU - Average Revenue Per Daily Active User
ARPPU - Average Revenue Per Paying User
ARPU - Average Revenue Per User
CAPEX - Capital Expenditures
CD - Compact Disc
CEO - Chief Executive Officer
CPA - Cost Per Acquisition
CPI - Cost Per Install
DCF - Discounted Cash Flow
DTA - Decision Tree Analysis
DVD - Digital Video Disc
DAU - Daily Active Users
EBITDA - Earnings Before Interest, Tax, Depreciation and Amortization
EV - Enterprise Value
FCF - Free Cash Flow
FPOM - Fuzzy Pay-Off Method
GBM - Geometric Brownian Motion
HD - High-Definition
HTML - Hyper Text Mark-up Language
IC - Invested Capital
IO - Input/Output
IPO - Initial Public Offering
IT - Information Technology
KPI - Key Performance Indicators
LTV - Lifetime Value
MAD - Market Asset Disclaimer
MAU - Monthly Active Users
MMORPG - Massively Multiplayer Online Role-Playing Game
M&A - Mergers and Acquisitions
NOPAT - Net Operating Profit After Taxes
NPV - Net Present Value
PC - Personal Computer
PDE - Partial Differential Equations
PV - Present Value
P/CF - Price to Cash Flow ratio
P/E - Price to Earnings ratio
P/EBIT - Price to Earnings Before Interest and Tax ratio
QA - Quality Assurance
RDTA - Real Option Decision Tree Analysis
ROI - Return On Investment
ROM - Read-Only Memory
ROV - Real Option Valuation
R&D - Research and Development
TV - Television
VR - Virtual Reality
WACC - Weighted Average Costs of Capital
3D - Three-dimensional
1. INTRODUCTION

Corporate mergers and acquisitions is one of the fastest way to enter to new locations and increase market share. Almost all managers of successful companies at certain point of time faced the question about what to do next or how to expand the company. The decision about company growth might have three possible outcomes – organic growth, innovations, and acquisition. (Lees, 2003) Organic growth means growth by increasing output and enhancing sales internally, and thus, increasing market share. It is a relatively slow way, because the desired market can be overwhelmed by the high competition. Relying on innovation is a quite risky way, because they require large investments and there is no guarantee of success. The potential innovation might face failure on the market. Acquisition is the fastest way of growth. It gives immediate access to acquired company’s markets, finance, technologies, management and other assets. (Lees, 2003)

Mergers and Acquisitions (M&A) is an area of strategic management and corporate finance that focuses on buying, selling, separating and combining different companies with the goal of achieving either a strategic advantage or maximizing growth and profits. (Hillier, et al., 2008) This is typically achieved through a type of restructuring within two or more companies. A merger is a combination of two companies to create a new company. This differs from acquisition which is a takeover of one company by another. More specifically, an acquisition is the action where a company buys at least the majority ownership of another company normally to coincide with a growth strategy. The M&A will be usually comprised of an acquiring firm, who gives the initial offer, and the target firm, which receives the offer. Acquisition can be friendly, when target company agreed to be acquired or hostile. (Hillier, et al., 2008)

An acquisition procedure can be divided into three stages: pre-acquisition (pre-combination), the actual acquisition (combination) and post acquisition (post-combination). (Marks & Mirvis, 2010) The first phase includes setting goals and strategy, targets screening, due diligence. In the second phase the deal is being managed and the transition process of finance and people is taking place. The last step involves post-acquisition action based on the original strategy, which might include for example integration of companies or splitting the business. A failure in the pre-acquisition stage might lead to a failure in all other stages and unsuccessful acquisition in general. This research will concentrate on pre-acquisition phase and in particular on the pre-acquisition target's screening. (Marks & Mirvis, 2010)
One of the fundamental problems of M&A on the pre-acquisition stage links to the features of many mergers and acquisitions: the acquiring company struggles to value the target’s resources correctly and the need to agree on the price of the acquisition between the parties. One of the reasons why target company valuation is challenging is a lack of information about it. One possible and a lot used way to get information is to perform due diligence – a detailed examination of a company and its financial records. (Cambridge Dictionary, 2016) But although due diligence might help to obtain detailed and reliable information about the quality of the resources to be acquired, it often fails to receive in-depth knowledge about the target’s resources that might affect the success of an acquisition. (Reuer, 2005) Also due diligence cannot be made without the consent of the target company, there has to be a preliminary offer or a plan on the table for a due diligence to take place. A target company valuation could be complicated as well by time pressure, organizational complexity, lack of knowledge about product or geographic markets and assessment of intangible assets.

Several scientific scholars, including strategy and organizational, draw attention to the fact that inappropriate decision-making, negotiation and integration process can lead to worse acquisition outcomes. (Cartwright & Schoenberg, 2006) Hence, the key to successful acquisition is an accurate target company valuation and selection of the best suitable target as a result.

1.1. Motivation for the research
M&A requires a thoughtful preparation and detailed analysis of target companies. A survey of M&A by Ernst&Young stated that 93% of respondents with deals of US$ 1 billion or more had a pre-signing synergies and/or integration plan in place. (EYGM Limited, 2015) Despite all possible benefits, acquisition is very costly and requires a lot of resources and time. Failure in this way of expansion may not only waste company’s resources but also worsen the entire state of the company. Therefore, a careful preparation for the deal and accurate valuation of target company, in particular acquisition risks and profit estimation, are crucial for successful deal.

The total value of M&A transactions globally has increased dramatically. Figure 1 demonstrates the annual value of the mergers and acquisitions worldwide for the period 2010-2015. One of the industries, that has started to make M&A deals frequently, is the video game industry. The game industry involves development, publishing and distribution of video games, electronic gaming devices, software and accessories. It can also be referred to as video game industry, game development industry, or interactive entertainment
industry and includes computer and mobile game industries. (Holger Langlotz, et al., 2008) The number of mergers and acquisitions in the video game industry and the average deal size increased significantly over the last several years. (Takahashi, 2014) In June 2016 the value of M&A in the industry reached US$25 billion for the period since January 2016, which is an absolute industry record. (Digi-Capital, 2016) Thus, the growing importance and number of cases to study encourage paying more attention to corporate acquisitions in game industry.

Figure 1. Value of mergers and acquisitions worldwide from 2010 to 2015 (in billion U.S. dollars) (Statista.com, 2016)

Valuation of an acquisition is accompanied by a high level of uncertainty. For example, defining a fair target value or forecasting acquisition synergies. From among different valuation methods the real option analysis is chosen as the tool used in this thesis. Real options valuation helps to address issues of irreversibility and uncertainty when undertaking investment and to optimize decision making in a dynamic and stochastic world. (Driouchi & Bennett, 2012) Several studies investigated M&A with real option approach, however, acquisitions in the video game industry was not sufficiently studied.

1.2. Research goal and research questions
The main goal of this research is to develop a decision-making method or a process, later “algorithm” for pre-acquisition target valuation in video game industry using real options valuation methods. This algorithm could be used by game development companies to simplify and to structure decision process of analyzing the potential targets and selecting the best target best potential target.
To achieve this goal several questions need to be answered:
• What important assets game company might have that attract acquiring company?
The information about target company’s assets could be found in company’s balance sheet or financial report. But if this information is unavailable, the valuation of the target could be challenging and may result in overpayment. Defining and describing essential assets for a game development company will facilitate the decision-making algorithm.

• What are possible motives for acquisition in the video game industry?
The reasons of why the company initiate an acquisition process might differ from industry to industry. Depending on what final goal is to set before the acquisition the outcomes might alter dramatically. Therefore, determining the most possible motives, which reflect the industry features, might increase accuracy and credibility of a valuation.

• What possible real options might appear in the case of acquisition in the video game industry?
The firm generally holds a portfolio of strategic (growth) and operating options, or in other words, strategic and operating flexibility capacities. These capacities help to not overlook uprising opportunities and treat risks. (Trigeorgis, 1996) By defining the most plausible for the gaming industry real options that reflect acquisition motives the valuation algorithm will be more focused and tailored to the video game industry needs.

1.3. Research methods
This research paper is dedicated to valuation of mergers and acquisitions with real option valuation methods. In particular, the aim is to develop a decision-making algorithm for pre-acquisition targets screening using real option valuation methodology that reflects video game industry features.

Valuation of acquisition is very complicated task because the result highly depends on the chosen model and metrics. There are different ways to perform a valuation of acquisition, and one of the most commonly used is Discounted Cash Flow (DFC) model. Although the DFC is a very simple to use method, it has limited ability to treat uncertainty. But since M&A procedures have a high level of uncertainty, the research requires models that has more flexibility and is able to take this uncertainty into consideration. One way to control uncertainty is real option analysis and it will be employed in this research. Target company valuation normally includes different types of uncertainty. One real option analysis method that can be applied in the presence of the type of uncertainty that surrounds acquisitions in the gaming industry context is the Pay-off Method. (Collan, 2012) Besides that, the results
from this method can be easily and intuitively visualized in comparison to other real option analysis methods.

The study of the game industry features will be performed by several semi-structured interviews with professional experts from the industry. The interview questions are designed to find the answers for the research questions. Conducted interviews facilitate deeper understanding of the industry and reveal the experts’ opinion about possible acquisition motives. The received data will be used as a basis for the algorithm development. Thus, from theory, practical cases and interview we can estimate potential target company’s assets possible real options and acquisition scenarios. Based on that, a decision-making algorithm will be developed for target company valuation, which fits the video game industry features.

1.4. Thesis structure
The structure of the research will be reflected in the structure of the thesis. An observation of previous studies dedicated to valuation of merger and acquisition with real option method and video game industry will be presented in the literature review section. A theoretical background chapter will include an observation of acquisition motives and a classifications of acquisition valuation methods. Also types of uncertainty and valuation methods based on real options will be evaluated in details.

The next chapter will be devoted to the video game industry. It will include information about history of industry development, specifics of the game industry and trends in M&A in the game industry. The most significant cases of M&A in the video game industry will be presented to illustrate current situation on the market.

Then the results of the experts’ interviews will be presented and discussed. Based on that results possible real options will be defined and valuation algorithm developed. The next section will observe a decision-making algorithm for the target company valuation and real options in the video game industry. A numerical illustration will follow the analysis. The conclusion will summarize answers to the research questions and the valuation algorithm.
2. LITERATURE REVIEW

Many researchers have devoted their work to M&A. It has been an attractive topic for research during over 40 years. (Cartwright, 2005) M&A has captured research attention of an extensive range of management fields of science. Although recently the human and psychological aspects of acquisition have been studied a lot, the M&A literature continues to be dominated by financial and market studies, particularly by researches about markets in the USA and the UK.

The strategic management and finance research in the M&A field are focusing mostly on the identification of the factors that may affect the success or failure of individual acquisitions. In particular, value-creation mechanisms within acquisitions have been investigated thoroughly. (Cartwright & Schoenberg, 2006) The value-creation mechanism could be based on resource sharing, for instance, as in work of Capron and Pistre (Capron & Pistre, 2002) or on knowledge transfer as in the research of Ahuja and Katila. (Ahuja & Katila, 2001)

2.1. Real option methods in mergers and acquisition studies

Valuation of M&A with real option methods is a relatively new direction of research. Different aspects of acquisition valuation have been reviewed from the real options position. Acquisition strategies as option games are discussed by Smit in 2001. (Smit, 2001) The work describes how real options and game theory approach can be used for valuation of corporate acquisition and especially buy-and-build strategy. The main idea is to consider an acquisition strategy as a package of corporate real options managed by the firm in a context of competitive responses or changing environment. Additionally, this work investigates the bidding game. Smit states that if two firms engage in bidding contest for follow-on acquisition they will have to pay for the deal at least some part of its synergetic option value.

Call option exercise problem is discussed in the work by Miller and Folta. (Miller & Folta, 2002) They investigate optimal exercise timing in terms of the incremental value with exercising entry option and how it might be affected by dividend pay-outs, pre-emption opportunities and the presence of embedded options. The dividends are the primary reason for early exercise option, because of opportunity cost the dividends forgone during the time the option is held. The same reaction is happening with pre-emption opportunities. The firm with goal of maximizing their value relatively to competitors would most probably exercise option prematurely and thus forfeiting option value. The delayed entrance instead may
evidence collision between competitors to increase collective option value. Additionally, the buyout option is discussed. The authors discover that an implicit buyout options can only have positive value for the firm with highest value-auditing complementary resources.

Tender offers and corporate control are studied with real options approach by Dapena and Fidalgo. (Dapena & Fidalgo, 2003) The added value of corporate control for investor comes from freedom of assets usage and source of finance. Dapena and Fidalgo analyze the acquisition process with a real option approach. They distinguish a waiting option and a growth option. The option to wait is available to all investors, the option to grow is in contrast a private opportunity for investor. Three ways of tender offer are described by Dapena and Fidalgo by making a tender offer to all outstanding shares, by direct or open market purchases, and by making a tender offer to certain percent of shareholders. A learning process is discussed in this work and the minority shareholding is considered as a tool for learning. The control of the firm is considered as an option. As long as the exercise price of this option does not react to the realize of information, the investors are “almost” proprietary of the option, because he or she might decide whether invest or not and can avoid bad state of nature. Otherwise, the exercise price with “limited control” will increase.

An early acquisition as a tool for uncertainty reduction related to formal technology standards is discussed by Warner, Fairbanks and Steensman. (Warner, et al., 2006) This problem might be relevant to any companies involved in R&D, for example in IT or game industry. The authors suggest that when an acquiring firm has not enough technical knowledge, it will make an acquisition before targets technology has been selected as the standard technology. In other words, if the firm desires to participate in formal building of standards, they must source a technology quickly, thus, an acquisition should be made prior to the standard. The patents in this case is considered as technical merit and thus companies with patents are first to be acquired. Firms with previous experience in acquisition are most likely to acquire again. Prior investments in equity alliances allow investors to move or intervene with greater confidence. Additional finding is the positive relationship between the pace of technological changes in the industry and the acquisition timing.

An analysis of strategic level real options is presented by Collan and Kinnunen. (Collan & Kinnunen, 2009) Based on the total value concept, the authors suggest that the stand-alone value of the target should include its strategic capital and the synergies should be derived from strategic capital that already exists in the target company. The paper discusses in
details different strategic options such as option to postpone, synergy as an option, option to split the business into parts, options to abandon non-core parts. The availability of information and important components needed for the target valuation are examined in this paper. The strategic level options are studied based on the case, which demonstrates that their existence does not create value and the holder of options must have the confidence and momentum to successfully exercise them.

2.2. Decision-supporting processes and systems designed to support M&A
Collan & Kinnunen (Collan & Kinnunen, 2009) developed a decision-making system supporting screening process of target companies in 2009. This system is based on multi-criteria analysis. The relevant characteristics related to each numerical input is graded by a decision-maker. Three scenarios are developed for inputs – extremely optimistic, extremely pessimistic and most likely scenario. Also a relevance value of characteristic is necessary for this analysis. The relevance value means examining how meaningful a factor is with respect to the financial input. The analysis is divided into several parts – target as a stand-alone company, which is divided into current information and future development, and synergy analysis. The synergies are divided by the sources: cost reduction, revenue increases and balance-sheet synergy.

The system requires both qualitative and quantitative data inputs and then check the consistency of the numerical inputs compared to qualitative characteristics. As the results, the system outputs the valuation of target’s analysis based on cash flow in a form of income statement with a separate parts for stand-alone cash flows and for synergies. (Collan & Kinnunen, 2009)

Another decision-making procedure of targets valuation with real options, namely with the Pay-off method, was developed by Collan and Kinnunen in 2011. (Collan & Kinnunen, 2011) The authors developed a procedure of a pre-acquisition screening of target companies with nine steps. The first step is to value potential target as a stand-alone company by estimating three scenarios of cumulative cash-flow estimates. The cash flow is estimated for each company’s unit with an option to select separate discount rate. After that, the present value of company’s cash-flow is calculated.

The next step is to calculate cash-flow from synergies investments with again three possible scenarios and separate discounted cash flow. Then the present value of synergies investment is calculated. After a sum of stand alone and synergies net present values are

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The next step is to calculate cash-flow from synergies investments with again three possible scenarios and separate discounted cash flow. Then the present value of synergies investment is calculated. After a sum of stand alone and synergies net present values are
calculated for each scenario, the pay-off distribution is generated to visualize targets possible value. Based on the shape and the width of the distribution the decision-maker can quickly draw conclusions about target. Next, a single descriptive number should be picked and calculated for the target: “the main NPV” and “ROV of synergies” and “Stand-alone NPV + Synergies NPV”. This is done with the possibilistic mean for triangular fuzzy numbers. Finally, after these steps are repeated for each target company, the most suitable target can be chosen. (Collan & Kinnunen, 2011)

The procedure allows to valuate targets rapidly and accurately. The synergy in this case is treated as a real option as well, and, thus, whole potential revenues are taken into account. The procedure can be applied under the condition of uncertainty and in the presence of inaccurate information. Different discount rates allow to receive more precise and realistic NPV. (Collan & Kinnunen, 2011)

Another decision-making tool is created to assist pre-acquisition screening of target companies by McIvor et al. (McIvora, et al., 2004) However, this study uses different method – fuzzy based system. The system uses the magnitude of the fuzzy membership functions to reflect the human precedence given to each financial ratio.

2.3. Video game industry studies
The video game industry has been studied mostly in the context of other ways of strategic expansion rather than acquisition, such as clustering as in De Vaan et al. (Vaan, et al., 2013) and network within industry as in Balland et al. (Balland, et al., 2013) and in Shankar and Bayus. (Shankar & Bayus, 2003) Value creation in the game industry has been examined through creating a conceptual framework in a study of Marchand and Thorsten. (Marchand & Hennig-Thurau, 2013) The study of Rochet and Tirole examined two-sided nature of the video game market. They found that indirect network effects connect game platforms sales to games sales. (Rochet & Tirole, 2003) However, mergers and acquisitions have never been examined for video game industry. This thesis is aiming to fill this gap and to apply M&A valuation methodology also to the video game industry.
3. THEORETICAL BACKGROUND

In this chapter target company’s valuation methodologies will be discussed with the goal of defining the optimal for the research purpose valuation method. First, theories clarifying motivation of acquisition will be revisited. Then two classifications of target company valuation methods will be presented and the place in the classifications of the real option valuation methodology will be established. Then real option valuation models will be discussed from the position of suitability for M&A target valuation and as the result the valuation model for the research will be chosen.

3.1. Acquisition motives – Trautwein theory

Target valuation is a complex and value-consuming procedure, at the same time it is crucial for successful investment. With some variations the general valuation process begins with setting the goal of the acquisition and defining the motives which drive the process. A popular study of acquisition motives is performed by Trautwein in 1990 (Trautwein, 1990) and basically it covers all possible reasons to initiate this process. The classification of motives developed by Trautwein includes seven theories: efficiency theory, monopoly theory, valuation theory, empire-building theory, process theory, raider theory, and disturbance theory. The focus is made on shareholder’s or manager’s interests or on the deviation they have on maximizing shareholder value.

*The efficiency theory* is based on the assumption that net gains coming through synergies. Synergies might be financial, operational and managerial. The aim of the acquiring company in the *monopoly theory* is to get market power. It can be achieved by conglomerate, through limiting competition in several markets and in many other ways. (Trautwein, 1990) In *the valuation theory* the acquirer benefits from net gains come through private information. It means that managers have better information about the target’s value in an acquisition than the stock market or use the acquired company to gain ownership in other companies. (Holderness & Sheehan, 1985) The net gains can be achieved, only when insider information from company is more valuable than the information from the market. The reason for that can be market information asymmetry. (Jensen, 1984) *The raider theory* assumes that the main motive is to gain from target shareholders’ wealth. In *the empire-building theory* the aim is analysed from manager’s benefits perspective. It means that manager is trying to maximize revenue or personal power through acquisition. *The disturbance theory* explains a macroeconomic level acquisitions. Acquisition waves could be results of economic disturbances. (Gort, 1969) *The process theory* states that the acquisition is not a completely rational choice but the process outcome. For example, the
decision can be affected by political power or organizational routines. (Trautwein, 1990) Rider, empire-building, process, and disturbance theories are excluded from the further analysis, because the aim of the valuation algorithm is to support rational acquisitions with an aim to maximize company's revenue and/or increase market share.

3.2. Valuation methods of the acquisition
After the motive or motives of the acquisition are determined, a list of potential targets should be chosen and related information should be collected. After the bunch of targets is chosen, the analysis may begin. The valuation process of a target consists of valuation of a target as stand-alone company and a valuation of a synergy which might bring the acquisition. The analysis of the target starts with analysis of a firm as a stand-alone company. Important to take into consideration not only the historical performance, but also the future performance of a potential target. (Petitt & Ferris, 2013) On this step Hiller, Grinblatt and Titman (Hillier, et al., 2008) suggest to revise any differences between the estimated value of the target and the target's pre-acquisition stock price. Stock price may reflect takeover probabilities and takeover premium, as well as the stand-alone value of the company. Thus, the analyst should revise the assumption about the cash flow and discount rate in a case of any differences with stock market. Then synergy should be assessed. The synergy means an additional value created by combining the firms. The goal of a synergy is to make the value of the target greater to the acquirer than the market value of the target on its own. In general, the target can be purchased if the sum of the stand-alone value of the company and the value of synergy is higher than the price of the deal.

3.2.1. Valuation method classification – Rosenbaum and Pearl
To get a reliable results a proper valuation method should be chosen. There are several methods to make a valuation. Rosenbaum and Pearl (Rosenbaum, et al., 2009) suggested the following classification of the most commonly used methodologies of valuation:
- Market-oriented methods;
- Methods based on cash flows;
- Methods based on assets.

3.2.1.1. Market-oriented methods
The first group of methods is based on a comparison of a target company with the market benchmark. It means comparing the typical characteristics of a target company and similar characteristics of other companies which exist in the market. A comparable companies' analysis method described by Rosenbaum and Pearl is developed to depict actual
companies’ values based on current market conditions and trends. (Rosenbaum, et al., 2009) The underlying idea is that similar companies present a very relevant indicator for the target valuation because the essential business attributes and risks are common for them.

The procedure of this analysis consists of five steps:
1. A bunch of comparable companies are selected. This step is crucial for the analysis and might be challenging for some companies. For listed companies it is quite easy to find companies with similar business and financial characteristics, however, for private companies this step requires deep understanding of the target.
2. Preparation of the necessary financial information. It could be equity research reports, press releases, consensus research estimates and other financial information.
3. Spread key statistics, ratios and trading multiples. This step requires calculation of market valuation measures such as equity and enterprise values, EBITDA, net income and other important indicators.
4. Market benchmark should be found. In this step the comparable companies should be examined and a target’s relative ranking and comparable should be determined.
5. The valuation of the target should be made, where the trading multiples of the comparable companies are used as a basis for obtaining a valuation range. As the most typical for the purpose of the analysis indicators Rosenbaum and Pearl allocate Enterprise value-to-EBITDA and Price/Earnings ratio. (Rosenbaum, et al., 2009) Additionally, to those indicators, Nikolova et al. (Nikolova, et al., 2011, p. 4) suggest Assets - to - Sales ratio.

A comparable companies’ analysis method is more relevant than intrinsic valuation analysis (for example, DCF) when one is after a present day market value for the target, because it is based on current market historical data. However, the market-based approach might negatively affect the results which can be skewed during periods of irrational exuberance or bearishness. Also, it might be impossible to find a relevant comparable for some businesses. (Rosenbaum, et al., 2009) Additionally, Nikolova et al. (Nikolova, et al., 2011, p. 4) point to inability of this methodology to take into account future company performance. This drawback might be crucial for the successful acquisition and might bring the company a significant loss.

Another popular market-oriented method is precedent transaction analysis. (Rosenbaum, et al., 2009) This method is very similar to the comparable companies’ method approach, but instead of valuing a comparable firm, concentrates on valuing comparable deal. The idea is to find an acquisition deal, that has already been made and has comparable
conditions, and use the value of that deal as a benchmark. But this method has several drawbacks that might be crucial for a proper target valuation. First of all, it might be impossible to find an appropriate comparable deal. Also the information about the deal may not be fully available. The time lag should also be considered, because market conditions may change dramatically. Another important issue to consider is implicit reasons that may lie behind the acquisition. It means that the value of the deal might be based on the acquiring company’s expectations about the future target performance.

3.2.1.2. Methods based on cash flows

The second group of methodologies is methods based on cash flow. The key objective of these methods is to consider the time value of money in the analysis. It means that the main input components are the future cash flows and outflows of the company and the determination of their present value. Discounted cash flow analysis is one of the most broadly used valuation methodologies for investment analysis.

The procedure of this analysis has also five steps as the comparable company’s analysis has. The analysis starts from a target examination and collecting information needed for the analysis. Then unlevered free cash flow (FCF) should be calculated. Next step is to calculate weighted average costs of capital (WACC). WACC can be calculated with the following formula:

\[
WACC = \text{After} \times (\text{tax Cost of Debt } \times \% \text{ of Debt in the Capital Structure} + \text{Cost of Equity } \times \% \text{ of Equity in the Capital Structure})
\]

Then the Terminal Value of a target should be estimated. The terminal value means the value of the target after the projection period. There are two most commonly used methods to calculate it - the perpetuity growth method and the exit multiple method. The first method allows to calculate terminal value by treating a company’s terminal year FCF as a perpetuity growing at an assumed rate. The second method determines the remaining value of a company’s FCF produced after the projection period on the basis of its terminal year EBITDA. (Rosenbaum, et al., 2009)

As a final step of DCF analysis, present value should be found and target company’s valuation should be performed. The present value calculation can be calculated by multiplying the free cash flow by the discount factor separate for each sub-period during the valuation period. The discount factor can be found with the following formula:
Discount Factor = \frac{1}{(1+\text{WACC})^n}, \quad (2)

where n is a year in the projection period.

PV of FCF_n = FCF_n \times \text{Discount factor}_n, \quad (3)

where n is a year in the projection period.

Additionally, sensitivity analysis can be performed. It allows to include some valuation of key inputs in the Discount cash-flow analysis. However, the sensitivity analysis can not fully treat the uncertainty about possible changes in inputs. (Nikolova, et al., 2011, p. 5) Another limitation is that basic DCF does not provide flexibility to change the company’s capital structure over the projection period. (Rosenbaum, et al., 2009)

Based on the Rosenbaum and Pearl classification, the real options method could be places in group of methods which are based on cash-flow. These methods will be discussed in details further in this chapter.

3.2.1.3. Methods based on assets

The third group of methods is based on assets. These methods can be used when the target operates without profit. (Nikolova, et al., 2011) When the target company has loss, assets could be a reliable source of information for company valuation. These methods usually estimate a relatively low value of the target companies.

Adjusted book value of assets is one of the methods based on assets. (Nicholas, 1990) The adjusted-balance-sheet approach to valuation involves a determination of the going-concern fair market value of all the assets and liabilities of a business. The difference between the assets and the liabilities is the adjusted net worth of the business. However, the adjusted book value of assets method is a time-consuming technique. Another drawback is difficulties in valuing intangible assets.

Cost of replacement can be used to determine the value of the target company. (Nikolova, et al., 2011) It is the estimated value of all tangible assets, for example buildings and equipment, and estimated value of intangible assets. The idea of this analysis is to estimate how much it will cost to create a new company just such as an existing one. It means to replace the target company with the new one.
3.2.2. Valuation method classification – Petitt and Ferris

More complicated and detailed classification of valuation methods is suggested by Petitt and Ferris (Petitt & Ferris, 2013) in a book “The valuation for mergers and acquisitions”. The authors classify methods into four categories based on two dimensions. One dimension contains direct valuation methods and indirect or relative methods and another divides methods into the group of methods that rely on cash flow and group that rely on another financial variables, for example sales, earnings and book value. The classification is presented in Table 1.

Table 1. Overview of Valuation Methods (Petitt & Ferris, 2013)

<table>
<thead>
<tr>
<th>Valuation methods that rely on cash flows</th>
<th>Direct or Absolute Valuation Methods</th>
<th>Relative or Indirect Valuation Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounted cash flow models: Free cash flow to the firm model; Free cash flow to equity model; Adjusted present value model</td>
<td>Price multiples: Price-to-cash-flow ratio</td>
<td></td>
</tr>
<tr>
<td>Economic income models: Economic value analysis</td>
<td>Price multiples: Price-to-earnings ratios (P/E ratio, P/EBIT ratio, and P/EBITDA ratio); Price-to-sales ratio; Price-to-book ratio; <em>Enterprise value multiples</em>: EV/EBITDA multiple; EV/Sales multiple</td>
<td></td>
</tr>
</tbody>
</table>

Direct estimate of a company’s fundamental value is provided by the direct valuation method. Fundamental or intrinsic value is based on the after-tax cash flows that the company expected to generate in the future, discounted at an appropriate rate that reflects the cash flows level of risk. (Petitt & Ferris, 2013) For public companies the fundamental price can be compared with market price. And if they are equal then the company is fairly valued. If the market prices are higher, the company is overvalued, otherwise it is undervalued. (Hillier, et al., 2008)

The indirect valuation methods do not indicate whether the company is fairly priced, they only show if it is fairly priced to some market benchmark. As Petitt and Ferris (Petitt & Ferris, 2013) state in their book, these methods represent fast but inaccurate approach to value a
target company. The relative methods require to identify a group of relative companies, that is why it is also called comparative approach.

The relative methods rely on the use of multiple, which is a ratio between two financial variables. (Petitt & Ferris, 2013) Often the numerator of the multiple is either the company market price or its enterprise value. The enterprise value is defined as a market capitalization of a firm's equity and the market value of a firm's debt. The denominator is usually an accounting metric such as book value, sale or earnings.

Petite and Ferris (Petitt & Ferris, 2013) suggest two group of multiples - Price and Enterprise value multiplies. As a most commonly used price multiples they propose the price-to-earning ratio (P/E). This ratio is equal to company's marketplace per share divided by its earnings per share, which means how much investors are willing to pay for a company's earnings. If the analyst wants to dismiss uncertainty related to the effect of a company financial strategy to earning, she might prefer to use price-to-earnings before interest and taxes ratio (P/EBIT). Price-to-earnings before interest, taxes, depreciation, and amortization ratio can be used to reduce the negative effect of accounting policies to earnings. All the ratios described above require positive accounting earnings, which is not the case of all companies. If the company operates with loss, then price-to-sales ratio should be used. For financial institutions and insurance companies, which have highly liquid assets and liabilities on their balance sheets, it is more suitable to use price-to-book ratio (P/B). Because this method would provide more realistic picture.

It is important to mention that earnings multiples could be calculated for a variety of time period. A trailing multiple is based on the last twelve months company’s data, which is usually reported quarterly. (Investor Glossary, 2004-2016) In contrast, a forward multiple is based on estimated future earnings per share. Sometimes it might be adjusted upward or downward to reflect changes in market sentiment. (Petitt & Ferris, 2013)

The only one relative method is based on cash flows - price-to-cash-flow ratio (P/CF). Some analysts may prefer to use this ratio instead of based on earnings, because cash flow is less sensitive to accounting choices and potential manipulations. (Petitt & Ferris, 2013)

While choosing between different targets, it might be paramount to measure both company's debt and equity. That is why enterprise value multiples exist. As in a case of price value multiples, the most commonly used ratios are enterprise value-to-EBITDA for
profitable companies and enterprise value-to-sales for unprofitable. The described multiples are frequently used in precedent transaction analysis and comparable company’s analysis methods which is described above. (Petitt & Ferris, 2013)

Direct valuation methods in contrast to relative methods provide investors with explicit value per share or share price objective. With no doubt the Discounted Cash Flow models are probably the most popular valuation models in corporate finance. The main flow of DCF model procedure has been already described. However, it is important to mention the difference between three models described by Petitt and Ferris. (Petitt & Ferris, 2013) The free cash flow to the firm model which has been described above, estimates company’s value based on its free cash flow to the company’s weighted average cost of capital. A free cash flow to equity model relies on FCFs available to equity holders instead of FCFs available to all capital providers, in other words, the firm’s FCFs minus CFs which go to all claimants other than common shareholders. The discount rate in this case is the cost of equity. As a result, this method provides direct estimate of a company’s equity value per share. Both of these methods are effective only when the firm’s capital structure is going to be stable over time. In other cases, the adjusted present value model should be applied. In this approach, which also known as a “divide and conquer” approach, the value of a target is estimated first as if an all-equity company were considering it, and then the tax benefit is calculated separately. (Howarth, 2009) The idea of this method is to diminish the effect of financial leverage changes on estimated company’s value. If the capital structure changes, then it will affect only the tax shield. As the result, the analysis becomes easier and quicker.

Another direct group of methods that is not based on cash flow is economic income models. (Petitt & Ferris, 2013) Another name of those models is residual income models and they are based on economic incomes rather than on accounting income. It can be explained by how the income is measured. For accounting income, the traditional measurement is deficient and it includes charges for the opportunity cost of debt but not for cost of equity. But economic income considers both of them. The main assumption of economic income model is that the company creates shareholder value only when the economic value is positive, and that the positive accounting income is a necessary but not sufficient condition in this case. The positive economic income is a key to high share price and valuation of the company.

One of the economic income models is the Edwards-Bell-Ohlson model. (Chen, et al., 2005) According to this model, the company’s stock value can be estimated as the book value
plus the present value of firm’s expected future residual income, discounted at the cost of equity. This model is popular in academic field, however, a model developed by Bennett Stewart and Joel Stern of Stern, Stewart & Company is more popular in practice. The economic value added model or EVA was developed in 1980s. EVA is based on an idea of free cash flow and the evaluation of business on a cash developed by Modigliani and Miller. (Miller & Modigliani, 1961) Economic Income based on EVA is calculated as:

\[
Economic\ Income = NOPAT - WACC \times IC,
\]

(4)

where NOPAT is net operating profit after taxes, WACC is weighted average cost of capital and IC stands for invested capital or in other words the sum of book value of debt and equity at the beginning of the book period. (Petitt & Ferris, 2013)

Economic income model is an entity method, which means that the entity value should be estimated before the equity value. (Petitt & Ferris, 2013) The procedure of this model contains several steps. First, the WACC needs to be calculated, then the amount of economic income needs to be counted. Next step is to estimate the continuing value with a perpetuity growth rate. After that, the entity value can be found by discounting the amount of economic income and the continuing value at the WACC plus cash and securities and the market value of non operating assets if relevant. Next step is to calculate the equity value. It can be done by deducting from the entity value the market values of debt, non controlling interest, equity-related securities other than common stock and contingent claim. Then the equity value per share can be estimated. (Petitt & Ferris, 2013)

The sensitivity of income model to accounting choices and the subjectivity of the adjustment to NOPAT and IC might be mentioned as potential drawbacks. (Petitt & Ferris, 2013) Also this model does not take explicitly into account the inflation and current changes in company value. Additionally, in the case of cyclical operating profit, changing of capital expenditure and low assets value, the results of economic income model might be unreliable.

The last but not the least direct method in Petitt and Ferris classification is real option model. In financial world an option is a right, but not the obligation to buy or to sell the underlying instrument, for example securities, at a prearranged price or up to a prearranged date. The term “real option” was introduced by Myers in 1977 (Myers, 1977) in work “Determinants of corporate borrowing”. In this article Myers points out that the firm consists of two components - real assets which have market values and real options which have opportunities to buy real assets on possible best price. Because of similarity between real and financial assets, the financial option valuation model can be applied to real options.
One of DCF limitation is its inability to treat entirely uncertainty, but the majority of companies operate in uncertain environment. (Petitt & Ferris, 2013) This uncertainty gives investment opportunities option-like features, which is difficult to value with DCF method. This issue is crucial for this thesis, because the aim is to accurately valuate target company. In contrast real option models gives flexibility in analysis and allows to take this uncertainty into consideration. This ability to takes uncertainty into consideration will be discussed later in this Chapter.

Real option model has been applied to different industries, fields of business and cases for last three decades. A company’s investment strategy and acquisition particularly are examples of real options model application. As it was mentioned earlier, the real option valuation methods have been applied on different fields of M&A. For example, acquisition strategies as option games (Smit, 2001) call option exercise problem (Miller & Folta, 2002) tender offers and corporate control (Dapena & Fidalgo, 2003) have been examined with real options. Several algorithms have been developed using real option for R&D development (Warner, et al., 2006) and target companies screening (Collan & Kinnunen, 2011). There are several real options models which can be used to estimate the value of the target. These methods will be discussed later in this Chapter.

3.3. Real Option valuation models
Real options can be considered as choices which manager could make while planning acquisition. An availability of different options or opportunities gives him flexibility. This flexibility and also an ability of real options model to take uncertainty into consideration should be discuss in more details. Choice of one or other option brings uncertainty about future it can lead to. The more distant the future that we need to evaluate, the more difficult it is to analyze. (Kyläheiko, 1998) The difficulties could be brought by increased complexity connected to the future or by decreasing amount of information about the future. (Collan, et al., 2016)

Moreover, the uncertainties might be different in nature, and we need to investigate what real option model best fit to which type of uncertainty. Collan, Haahtela and Kyläheiko (Collan, et al., 2016) made an in-depth analysis of how different types of uncertainty are treated by different types of real option model. The authors used the definition of uncertainty by K. Arrow (Arrow, 1974), since our knowledge of the world description is limited and the world is considered “to be one or another of a range of states”, the uncertainty is our non-acquaintance about which of these states is a true one.
Table 2. Examples of uncertainty for target company valuation.

<table>
<thead>
<tr>
<th>Uncertainty type</th>
<th>Examples uncertainty related to target valuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parametric</td>
<td>We uncertain about values of parameters we use for target company valuation, e.g. value of company’s assets.</td>
</tr>
<tr>
<td>Structural</td>
<td>Valuation models give just approximation of reality, thus incapacity to 100% accurately value target company is an example of structural uncertainty.</td>
</tr>
<tr>
<td>Procedural</td>
<td>One example of this type of uncertainty related to the pre-acquisition process could be inability of managers to value target company correctly due to complexity of the problem.</td>
</tr>
<tr>
<td>Substantive</td>
<td>Since the valuation can take place before due diligence, important information about target company’s value can be missing.</td>
</tr>
</tbody>
</table>

Table 2 presents examples of each type of uncertainty except radical which decision-maker could face while valuation target company. According to Collan et al., (Collan, et al., 2016) this is parametric uncertainty view. Overall the authors derived the following types of uncertainty:

1. Parametric uncertainty means that an agent has no knowledge about parameters of the decision problem, but aware about the structure of the decision.
2. Structural uncertainty meant that an agent has incomplete knowledge about the structure of the future;
3. Procedural uncertainty refers to the lack of sufficient cognitive competencies of the decision maker;
4. Substantive uncertainty refers to the lack of necessary information about outcomes. But this type of uncertainty covers both parametric and structural uncertainties, thus, only them will be used for this analysis.
5. Radical – an extreme end of certainty-uncertainty continuum, in which numerical calculations are no longer possible. Since it is the most extreme form, it wasn’t included in the analysis of Collan et al.
In the continuation of this chapter the description of real options valuation models will be discussed as well as the way these models treat the uncertainty. Real option valuation models could be classified by the mathematical methods underlying each model. (Collan, et al., 2016) The following groups of models are going to be discuss in this chapter:

- Differential equation-based;
- Lattice-based;
- Market asset disclaimer (MAD);
- Decision tree analysis;
- Simulation-based;
- Fuzzy pay-off distribution based.

Before explaining each model in details it is important to describe the logic which lies behind real option valuation. By definition the financial option is securities that give a right but not an obligation to buy or sell an underlying asset while the time and the price of this deal are predetermined. (Collan, 2012) The same principles that lies behind financial options valuation is applied to the real options valuation. The real options valuation problem consists of three main steps:

1. Estimation of future value distribution – the range of future values of the underlying asset.
2. Since we have a right but not the obligation, we will not use option if it will bring money loose. That is why we assign all negative values a value of zero, when calculating the expected value of the future value distribution.
3. The present value of the option should be determined (NPV of the expected values).

3.1.1. Differential equation-based models

Differential equation-based models use partial differential equations (PDE) to depict the real option price and its changes over time. The main assumption of this type of ROV models is that underlying assets follow geometric Brownian motion (GBM) and are subject to stochastic variations. (Barton & Lawryshyn, 2011) Moreover, a common assumption is that the returns are normally distributed. In other words, if the options valuation is made by using GBM, it is considered that underlying assets behave in the same way. This was made to simplify the reality (in a way it became mathematically tractable. (Collan, et al., 2016)

The most commonly use of differential equation-based model is Black-Scholes model developed by Fischer Black and Myron Scholes in 1973. (Black & Scholes, 1973) This model has several important assumptions:
1. Constant and known in advance interest rate;
2. The variance rate of the return is constant. The underlying asset follows a random walk in continues time, thus the distribution of possible values of underlying asset at the end of any finite interval is log-normal;
3. There are no dividends.
4. There are no transaction costs;
5. The option can be exercised only at maturity (European option)
6. No transaction costs;
7. Short selling is available;
8. It is possible to borrow any fraction of the asset.

To depict the price of the option over time Black-Scholes (Black & Scholes, 1973) model uses PDE:

$$\frac{\partial V}{\partial t} + \frac{1}{2} \sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS \frac{\partial V}{\partial S} - rV = 0,$$  \hspace{1cm} (5)

where \( V \) is the price of the option, \( t \) is time to maturity, \( \delta \) is volatility of the asset's return, \( S \) is the price of the stock, \( r \) is a risk-free interest rate.

The value of the call option can be obtained by solving the PDE with corresponding terminal and boundary conditions:

$$C = SN(d_1) - Xe^{-r(T-t)}N(d_2),$$  \hspace{1cm} (6)

$$d_1 = \frac{\ln(S/X) + (r+\frac{1}{2}\sigma^2)(T-t)}{\sigma \sqrt{T-t}},$$  \hspace{1cm} (7)

$$d_2 = d_1 - \sigma \sqrt{T-t},$$  \hspace{1cm} (8)

where \( N(d) \) is a cumulative normal density function, \( T-t \) is a time to maturity, \( X \) is an exercise (strike) price of the option. (Black & Scholes, 1973) An increase in maturity has the same effect on the value of the option as an equal percentage increase in both \( r \) and \( \sigma^2 \). The price of the corresponding put option is developed based on call-put parity:

$$P = N(-d_2)Ke^{-r(T-t)} - N(-d_1)S$$  \hspace{1cm} (9)

Differential equation-based models are theoretically well aligned with the mainstream financial economic theory, however, those models need to be adjusted for any practical use. (Collan, et al., 2016) Strict assumptions make the use of this model in real-life cases problematic. But all adjustments and customizations require complex mathematical manipulations and are time-consuming.
Another drawback of this type of ROV models is that it requires the ability to estimate the value of several parameters. (Collan, et al., 2016) These parameters can be obtained only if we assume that the market of underlying assets is under parametric uncertainty. This fact is also supported by an observation that differential equation-based models are mostly applied to analyses of natural resources investments. Information for these analyses in a form of historical raw materials’ prices is usually available for estimating the underlying asset process parameters and structural and procedural uncertainties are not involved. Thus, the use of this model type for acquisition valuation is rather limited since the target valuation involves different types of uncertainty.

3.1.2. Lattice-based models
Lattice valuation methods involve constructing binominal (trinomial or quadrinomial) tree, which reflect different possible ways that the underlying asset value may follow. The main assumption is that the value of the underlying asset follows the random walk. In each time step, it has a certain probability of moving up by a certain percentage amount and a certain probability of moving down by a certain percentage amount. This model becomes resembling the Black–Scholes model, when steps become smaller. (Hull, 2012) When an infinite number of time steps is involved in calculations, the tree represents a discrete illustration of a continues evolution of asset value. (Collan, et al., 2016) The binomial tree, the simplest form of lattice model, was introduced in 1979 by Cox, Ross, and Rubinstein. (Cox, 1979)

![Figure 2. Two-steps binominal tree (Hull, 2012)]
Figure 2 depicts two-steps binominal tree, where $S_0$ represents initial price of the underlying asset. First step of this method involves estimation of the length of the time step on a binominal tree, $\Delta t$, which could be found by using the following formulas, which match the volatility:

$$u = e^{\sigma \sqrt{\Delta t}}$$  \hspace{1cm} (10)

$$d = e^{-\sigma \sqrt{\Delta t}}$$  \hspace{1cm} (11)

The value of the risk-neutral probability is

$$p = \frac{a-d}{u-d}$$  \hspace{1cm} (12)

where

$$a = e^{r \Delta t}$$  \hspace{1cm} (13)

The second step involves obtaining the value of the real option at each final node. (Hull, 2012) The value of the option is its intrinsic value - $\text{MAX}[(S-K), 0]$ for a call option and $\text{MAX}[(K-S), 0]$ for a put option, where $K$ is the strike (exercise) price and $S$ is a spot price of the underlying asset. The last step is to find the value of the option at earlier nodes and finally the present value of the option. This is the formula of European call option $C$ at time $T-n$:

$$C = \frac{1}{(1+r)^n} \sum_{j=0}^{n} \binom{n}{j} p^j (1-p)^{n-j} [(1+u)^j (1+d)^{n-j} S_{T-n} - K]$$  \hspace{1cm} (14)

where $C$ refers to the price of a European option before expiration at time $T$ with $n$ time steps before the expiration, $S$ is the underlying asset price, $K$ is the strike price, $r$ denotes the discount rate for each time step, $p$ is the probability of an upward and $1-p$ is the probability for a downward movement, $a$ is the summation of the minimum number of up-ticks so that the call finishes in-the-money. (Hull, 2012)

Lattice-based models allow to valuate not only European, but also American options, the options that can be exercised before the maturity, and compound options compared to PDE-based models. Although this type of ROV model is more flexible than differential equation-based type, it requires the same type of information. Thus, Lattice-based models also deal with parametric uncertainty.

If the real option problem is rather complex, the size of the tree can become large, however, lattice-based models provide a straightforward yet flexible way to perform real option valuation using decision analysis software. (Brandão, et al., 2005) However, since this type of ROV models uses the same information as differential equation-based model it will be difficult to use it to value acquisition.
3.1.3. Marketed asset disclaimer models
The approach that lies behind Marketed asset disclaimer models was introduced by Copeland and Antikarov in 2001. (Alexander, et al., 2014) This approach is making a trade-off between the separate valuation of the base investment and the attached real option. For the former a DCF analysis is used, and for the latter the standard risk-neutral financial option valuation technique is employed. Copeland and Antikarov demonstrate that when the information about the market price is unavailable, the best guess of the base investment current value could be found with DCF, and that this base investment could be used for hedging of the related real option, in a manner that the ROV valuation is performed under the risk-neutral measure.

The risk-neutral ROV requires the gross or net investment value computed by the discount cash flow method at time 0 to become the risk-neutral measure. To perform this valuation, the risk-adjusted discount rate is required. (Alexander, et al., 2014) The variations in the gross NPV of the base investments is assumed to follow a random walk. Thus, the GBM as a stochastic process is used for the value of the underlying asset. By means of these assumptions the authors of the approach propose the use of simulations to obtain required information about standard deviation of the base investments value. Base on MAD assumption it is possible to reckon that this type of ROV model is dealing with parametric uncertainty as all the previous types. (Collan, et al., 2016)

Risk neutral probabilities are used by MAD models for ROV. The actual probabilities (expected by experts) can be converted to risk-neutral by means of binominal tree parametrization. There are several extensions of the original MAD model and they are better adjusted to the situations with elements of structural uncertainty. In these cases, the usage model extensions should be attentively evaluated and probably supplemented by other ROV models. (Collan, et al., 2016)

3.1.4. Models based on decision tree analysis
Real option decision tree analysis (RDTA) is based on decision tree analysis (DTA), which serves to model managerial flexibility in discrete time by means of a tree with decision nodes as manager’s decisions that are maximizing the value of the project as uncertainties are resolved over the project’s life. (Brandão, et al., 2005) In this ROV types of model the estimated probabilities are converted to risk-neutral probabilities by replacing the used discount rate with the risk-free discount rate, which is more available on the markets. It means that the risk of each branch of choices in the RDTA is reflected by the used risk-
neutral probability, while the discount rate remains the constant risk-free rate. (Collan, et al., 2016)

This model requires the same assumptions as the MAD models that the present value is considered to be the best estimate of project market value and that standard deviation of the project returns follow a random walk. The value of real option can be simply derived by observing the value of the project estimated with RDTA and DTA, since RDTA includes real options in the project value. Since the basis of RDTA is a capability to model decision tree which includes all possible outcomes of the problem and to estimate the actual probabilities of each alternative, RDTA is considered to deal with structural uncertainty. But not only information about structure of the problem is needed but also the information about the parameters which is the ground for the parametric type of uncertainty. (Collan, et al., 2016)

An advantage of this model type comes from the fact that RDTA treats different sources of uncertainty separately, thus, this approach is relevant in many application areas. According to Collan et al, it can always be applied to cases under parametric uncertainty and in some cases characterized by structural uncertainty. Collan et al. made an example of former cases as one when the results based on different starting assumptions, thus, referring to different structures. The possible drawback is that the results might be unbiased, because the precise estimation of the actual probabilities is not possible any more. On the other hand, one advantage of the RDTA, besides that it is relevant in many application areas, is that it gives good visualization to managerial problems by providing a graphical overview of the expected possible relevant alternatives. (Collan, et al., 2016) This ROV model type is an intuitively understandable method, however, its ability to treat all possible types of uncertainty is rather limited. Thus, for the purpose of this analyses this model type is not optimal.

3.1.5. Simulation-based models
This type of ROV model is one of the most resent and uses simulations to build payoff distributions. One of the most commonly used simulation-based ROV model was developed by Vinay Datar and Scott Mathews in 2004. (Datar & Mathews, 2004) This model is algebraically equivalent to the Black-Scholes formula, when the assumption of the former is employed in simulation modelling, the results of both models converge.

This model leans on cash-flow scenarios for the operational cash-flow of an investment project that is the real option. The cash-flow distribution relies not on imitating a preselected
process followed by underlying process, but on experts’ view on the underlying project’s
cash-flows and their variance. The role of experts can perform the managers that are in
charge of the project. (Collan, et al., 2016) The cash-flow scenarios are used as an input
into a Monte Carlo simulation that serves to create a probability distribution of the expected
net present value for the project that is being analysed. Datar-Mathews method can be seen
as an extension of the NPV multi-scenario Monte Carlo model with an adjustment for risk-
aversion and economic decision making. (Mathews, 2009) Thus, The Monte Carlo
simulation model needs to be explained.

The Monte Carlo simulation-based application was developed by Boyle (Boyle, 1977) and
is often referred to as one of the earliest simulation models for option valuation. The main
idea of this method is that the stochastic process of the payoff distribution is approximated
numerically with a simulator. To perform this approximation several random paths for cash-
flow scenarios are made in a risk-neutral world with a simulator and the option payoff at the
maturity is estimated for each path. To receive a valuation of the expected payoff in a risk-
neutral world the mean of the sample payoffs is calculated. Then the expected payoff is
discounted to present value at the risk-free rate of interest to get the value of the option.

But returning to the procedure of the Datar-Mathews model (Datar, et al., 2007), it allows to
used separate discount rates for operational and investment cash-flows. It means that the
future cash-flow distribution is discounted to the present value with a discount rate that is
an alternative cost for the risk level, at which the cash-flows take place. (Collan, et al., 2016)
The expected real option payoff can be calculated as a “mean of the 'in the money' side of
the real option payoff distribution multiplied to the probability of being in the money plus
probability of not being in the money multiplied by zero”. (Collan, 2011) Or can be simplified
as the following formula:

\[
\text{Real option value} = \text{Risk} - \text{adjusted success probability} \times (\text{Benefits} - \text{Costs})
\]

(15)

Simulations can be employed not only to model payoff distribution but also for the obtaining
of the parameters needed for real option valuation, for example, volatility. (Brandão, et al.,
2005)

Another example of ROV models that use simulations are system-based models. According
to article of Richard de Neufville (de Neufville, et al., 2004), there are two types of real option
in technical projects: options “on” and “in” systems. The former considers the technology as
a black box, and the latter gives the flexibility through the details of the design. The “in”
options are used as a basis of system-based models. This example can be generalized to
the idea that these models are modelling an investment with real options as a part of the system and including their dynamic nature in the analysis. (Wang & de Neufville, 2005) In these models simulation is employed to perform the testing of the constructed system models and the comparison of different system configurations. (Collan, et al., 2016)

One of the simulation-based models advantages is comparative usability: there are available software to perform this analysis and to make simulations. Another advantage is that these models do not require stick to the strict assumptions normally required, when stochastic processes are used. But with all its advantaged this ROV model type is dealing with parametric uncertainty type. With some limitations this model type is also treating structural uncertainty since it is possible to generate simulation models that characterise structurally different starting points. But the usage of these models for structural uncertainty should be carefully evaluated. (Collan, et al., 2016)

3.1.6. Fuzzy pay-off distribution-based models
Fuzzy logic and arithmetic is a mathematical set of tools that help to deal with “imprecision in a precise way." (Collan, 2012) This type of ROV models is not the first that uses experts’ opinion about possible distribution of underlying asset’s value, but the first to assume that the ability of experts to estimate parameter values used in models or the size and the timing of future cash-flows is always imprecise to a degree. (Collan, et al., 2016)

Fuzzy logic and arithmetic that lies behind fuzzy pay-off distribution-based models was invented by Lotfi A. Zadeh 1965. (Zadeh, 1965) The main idea of fuzzy sets theory is to use membership function with \( E(f) = [0,1] \) and \( D(f) = (-\infty; +\infty) \). It means that, in contrast to classical set theory, fuzzy set theory allows the gradual assessment of the membership of the elements in a set.

A fuzzy set \( A \in F \) is a trapezoidal fuzzy number with core \([a,b]\), left width \( \alpha \) and right width \( \beta \) if its membership function has the following form (Collan, et al., 2009):

\[
A(t) = \begin{cases} 
1 - \frac{\alpha - t}{\alpha} & \text{if } a - \alpha \leq t < a \\
1 & \text{if } a \leq t \leq b \\
1 - \frac{t - b}{\beta} & \text{if } b < t \leq b + \beta \\
0 & \text{if } t \notin [a - \alpha, b + \beta] 
\end{cases}
\]

Fuzzy sets theory has been used together with many different ROV models types such as differential equation-based, lattice-based and RTDA models. These combination of models are generally usable under the same types of uncertainty as the underlying original methods with crisp (non-fuzzy) numbers. (Collan, et al., 2016)
The fuzzy pay-off method (FPOM) is a model for investment analysis and based on similar construct as the Datar-Mathews model – it uses cash-flow scenarios estimated by experts in the creation of net present value pay-off distribution for the real option. But the difference between these two models is that FPOM treats the pay-off distribution as fuzzy number, but not as possibility distribution. (Collan, 2011)

The valuation procedure with FPOM starts from estimation of the scenarios for the investments by experts: the minimum, the best guess and the maximum possible situations. NPVs of cash-flow scenarios are used to directly map a fuzzy number pay-off distribution for a project. Then the pay-off distribution is a distribution of the possible NPV values for an investment and is created using these scenarios:

- The best guess scenario is the most likely one and it’s assigned full membership (full grade of membership) in the set of possible outcomes. The NPV of the investment is calculated by using separate risk adjusted discount rates for operational revenues and for operational costs (or by assigning separate discount rates for sub-categories of revenues and costs).
- The minimum and the maximum scenarios are considered to be the upper and the lower bounds of the distribution. The simplifying assumption is that the values higher then maximum scenario and the lower than the minimum scenario are not considered in the analysis.
- The shape of the distribution is assumed to be triangular. Also the trapezoidal shape can be employed. (Collan, 2012)

Since the FPOM for ROV relies on the idea that the real option value for an investment can be directly calculated from the investment’s fuzzy NPV, the next step would be to treat the triangular distribution that we received as fuzzy numbers. We denote the minimum, the maximum and the best-guess net present values as \((a-\alpha)\), \((a+\beta)\) and \((a)\) respectively. Thus, the distance between best guess and maximum scenario NPV is \(\beta\) and the distance between the best guess and minimum scenario NPV is \(\alpha\). (Collan, 2012)

Figure 3 illustrates an example of the fuzzy pay-off distribution. Important to notice that all negative values should be mapped zero, because real option is right but not an obligation and the owner of the option will not make the decision that will bring him losses. The zeros in the real option pay-off distribution retain the same area under the fuzzy number that was previously ‘occupied’ by the negative NPV values. This is in line with the ROV logic and the same procedure is used also in the Datar-Mathews model. (Collan, 2012)
We can have several observations from our pay-off distribution:

- The wider the distribution, the more imprecise the estimate of the project profitability is.
- The height shows us to what degree the different values are possible. The closer values to the peak, the more possible.
- The “success ratio” represents proportion of non-negative outcomes area to the total area. (Collan, 2012)

Now when we have triangular pay-off distribution as a fuzzy number we can estimate real option value. The value of the real option can be obtained as the possibilistic mean of the positive side area weighted by the positive area of the pay-off distribution over the whole area of the pay-off distribution. (Carlsson & Fullér, 2001) An important remark is that the calculation differs from the calculation of the probabilistic expected value, because the pay-off distribution now is a fuzzy number - possibility distribution. The formula of the real option value is the following:

\[
ROV = \frac{\int_{-\infty}^{0} A(x)dx}{\int_{-\infty}^{\infty} A(x)dx} \cdot E(A_{+})
\]

where A denotes as the fuzzy real option pay-off distribution, \( E(A_{+}) \) represents the possibilistic mean value of the positive side of the fuzzy real option pay-off distribution,
\[ \int_0^\infty A(x)dx \] is the area below the positive part of \( A \), and \( \int_{-\infty}^0 A(x)dx \) is the area of the whole fuzzy real option pay-off distribution. (Collan, 2012)

There are four cases, in which the formula for calculation the positive side of the fuzzy real option pay-off distribution is slightly different:

1. When the whole pay-off distribution is positive:
\[ E(\hat{A}_+) = a + \frac{\beta-a}{6} \]  

When the pay-off distribution is partially above zero and zero is between the minimum and the best guess NPV scenario:
\[ E(\hat{A}_+) = a + \frac{\beta-a}{6} + \frac{(a-a)^3}{6a^2} \]  

1. When the pay-off distribution is partially above zero and zero is equal to the best guess NPV or between the best guess and the maximum NPV scenario:
\[ E(\hat{A}_+) = \frac{(a-\beta)^3}{6\beta^2} \]

2. When the whole pay-off distribution is below zero:
\[ E(\hat{A}_+) = 0 \]

3. The whole distribution area is easily calculated as:
\[ A = \frac{1}{2} \text{height} \times \text{width} \]

One of the advantages of this model is its comparative usability and very simple calculations that are employed in this method. Also a spreadsheet software is applicable for this method, which simplify the valuation procedure. (Collan, et al., 2016)

Because both subjective and objective data can be utilized in the creation of the cash-flow scenarios and the type of information required for this model can range from hunches to detailed qualitative historical data-based information FPOM can be useful even under structural and procedural uncertainty and as well as under parametric uncertainty. This makes this model universal for valuation of projects involving different types of uncertainty. Especially this model is helpful for valuation of acquisition, because it was originally designed for situations with limited information (Collan, et al., 2016)

Table 3 demonstrates all ROV models that have been introduces in this chapter. As we can see from the table, only one model can treat all types of uncertainty – the fuzzy pay-off model. It means that the model gives more managerial flexibility and could be better utilized when little information is available. This is the exact situation which might happen when
company is planning acquisition. That is why this method will be used for the purpose of this research.

In this chapter we focused on revision of target company’s valuation methods. The first section of the chapter described and discussed two classification of acquisition valuation methods. One classification was developed by Rosenbaum and Pearl and the second by Pettit and Ferris. In this classifications real option valuation methods were discussed as an accurate and flexible method compared to other popular valuation methodologies. These methods directly measure company’s value, and successfully treats uncertainty related to limited information more carefully than other methods. Therefore, real option methods are more suitable for an accurate pre-acquisition targets’ valuation.

The second section of this chapter described different real option valuation models, classified based on mathematical underlying methods. These models have been reviewed from the point of capability to manage different types of uncertainty related to the valuation process. Based on that review the pay-off methods for real option valuation was chosen among other real option methods for the research, because it is the only one of the reviewed methods that can be used under parametric, structural, and procedural uncertainty and thus is flexible enough for the valuation of M&A in the context of the gaming industry.
<table>
<thead>
<tr>
<th>Model type</th>
<th>Technique that the model based on</th>
<th>Advantageous</th>
<th>Disadvantageous</th>
<th>Type of uncertainty involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differential equation based models</td>
<td>Geometric Brownian Motion + PDE</td>
<td>Well aligned with financial theory</td>
<td>Strict limitations make it difficult to use in real life, might be used only with European options</td>
<td>Parametric</td>
</tr>
<tr>
<td>Lattice-based models</td>
<td>Binomial tree process + risk-neutral valuation</td>
<td>Can be use with both European and American options, usability</td>
<td>Requires to know many parameters in advance, might be imprecise</td>
<td>Parametric</td>
</tr>
<tr>
<td>Marketed asset disclaimer models</td>
<td>Geometric Brownian Motion + DCF analysis + risk-neutral financial option valuation</td>
<td>Can be tailored for the decision situations with elements of structural uncertainty</td>
<td>MAD assumptions bring limitations</td>
<td>Parametric, structural (with limitations)</td>
</tr>
<tr>
<td>Models based on decision tree analysis</td>
<td>Decision tree analysis</td>
<td>Gives good visualization</td>
<td>Requires ex-ante knowledge about the structure</td>
<td>Parametric, structural (with limitations)</td>
</tr>
<tr>
<td>Simulation-based models</td>
<td>Cash-flow scenarios + MC simulation</td>
<td>Usability, no strict assumptions</td>
<td>Requires to know many parameters in advance</td>
<td>Parametric, structural (with limitations)</td>
</tr>
<tr>
<td>Fuzzy pay-off distribution-based models</td>
<td>Cash-flow scenarios + fuzzy logic</td>
<td>Good visualization, usability, accuracy, treats uncertainty very well</td>
<td>Relies on experts’ opinion, which might be falsely</td>
<td>Parametric, structural, procedural</td>
</tr>
</tbody>
</table>
4. VIDEO GAME INDUSTRY OVERVIEW

In this chapter the video game industry and its features will be examined. An overview of the video game industry development will be given to track the important trends and aspects of this business sphere. Statistical data will be presented to demonstrate current state of the industry. Also the situation with M&A will be discussed separately with examples of several significant cases which recently took place.

The game industry involves development, publishing and distribution of video games, electronic gaming devices, software and accessories. It also can be referred as video game industry, game development industry or interactive entertainment industry and includes computer and mobile game industry. (Holger Langlotz, et al., 2008) It is independent economic sector that engages thousands of people worldwide. Nowadays game industry has multibillion revenue.

4.1. History of video game industry

In this subsection the development of the video game industry will be discussed. A brief overview of described important events for the industry is illustrated in Appendix 2. The development of video games goes along with the development of computer science. Even very first digital computers were used not only for research purposes but also for entertainment. It is impossible to say who developed the first video game in the world, because they were never reported, but the first known games were a chess simulation created by Alan Turing and David Champernowne and Bertie the Brain by Josef Kates and Rogers Majestic. The former was never implemented on the computer, but the latter was not only implemented but also presented at the Canadian National Exhibition in 1950. (Computer History Museum) The first computer games were simple and their capacities were limited by computers small memory and low speed. The spread of the first games was very local, because the first computers could be used only by scientists. The first step that lead to a wider spread of video games was involvement of students of Massachusetts Institute of Technology into research work with the first digital computers. These students developed a new model of computer, largely improved its speed and memory capacity while making the productive cost of such a computer much smaller. Together with these improvements they developed a computer game named “Spacewar!”, which was trendy among students and therefore made an impact to the video game popularization. (Parnell, 2012)
By 1970 further development of computer technology lead to significant decrease in computers retail prices. They were still too expensive for private usage, but affordable for businesses. It gave rise to coin-operated game industry or arcade game industry. Previously mentioned game “Spacewar!” inspired Nolan Bushell and Ted Dabney to create a game called “Computer Space”. This coin-operated game became very trendy quite soon. Meantime R. Baer invented the technology that allowed to play video games on a standard television set. He launched a system called the Magnavox Odyssey in collaboration with television company Magnavox in 1972. (June, 2013) Both of these games didn’t change the market dramatically, but were the first steps in the development of new industries – arcade game and video consoles.

4.1.1. Arcade games and coin-operated machines
A booming development of coin-operated games was very important step in the popularization of computer games. The first commercially successful coin-operated game was Pong, a table tennis simulator, developed by N. Bushnell. (Rubin, 2014) In the beginning of 70s arcade coin-operated games became widely installed in many shopping malls across USA. It has been a safe place for parents to leave their children while shopping, that is why this format became very popular. (June, 2013)

Meanwhile arcade video games were passing through the second wave of success. It happened because of the rapid development of game market in Japan. A game named “Space Invaders” was introduced to public in 1978. (Rignall, 2016) It became very popular in both the USA and Japan very soon, because of its creative gamification. This game implemented several features such as play regulated by lives instead of timer or scores, ability to gain additional lives and recording the highest score on the machine. These features later became widely used in other games. Another legendary arcade game of that time is “Pac Man”. It was released in 1980 in Japan and more than 100000 machines has been sold during the first year. This game inspired production of many sequels and even cartoon. (BANDAI NAMCO Entertainment Ltd., 2016) These two games and many more caused significant changes on the market. The revenue boosted to $2.8 billion, which is 3 times more than in 1979 and 9 time more than in 1978. That is why this period, 1978-1982, often referred as “the Golden Age”. (Smith, 2013)

At the end of 1980s the popularity of arcade games began to decline due to increase interest in games for home computers and consoles. However, the publication of “Street Fighter II” by Capcom brought back the popularity of arcade games. Several other one-to-one fighting
games became popular in the beginning of 1990s, such as “Mortal Kombat” and “The King of Fighters”. (June, 2013) In the mean time 3D graphics was implemented in arcade games for the first time, involving many companies into production of soft- and hardware for 3D graphics. However, the success of arcade games was eclipsed by 3D games for consoles and PC computers. (BBC News, 2011) The attention of both customers and game developers was attracted to games that could be played at home rather than in the shopping malls arcade centers. Coin-operated games became more technically complicated and had expensive game control systems to compensate the lost of customers’ interest. New games were based on different sport activities and hobbies, for example skiing, cycling and dancing. However, it didn’t help to get fully back gamers’ attention.

4.1.2. Games for mainframe and personal computers
At first, mainframe computers were not widely in use for game development because of their limited capacities. However, in the beginning of 1980s several important inventions have been made which allow to develop more sophisticated and interesting games for mainframe computers:

- Developing of new high level programming languages (for example, C). Those languages are more user-friendly and, thus, attract more new game developers;
- Creation of UNIX operating system simplifies programming procedure and sharing of codes between different developers;
- Invention of time-sharing technology, which also lead to improvement of developing procedure since more developers could use a computer at the same time. (Ritchie, 1996) These inventions, however, affected game development not only for mainframes, but also for personal computers. Also many games created for mainframe computers latter were used for personal computers and consoles.

The development of games for home computers started in the beginning of 1980s along with the development and spread of home computers. At the beginning those games were mostly replicas of popular mainframe computers games, but later home computer users started to develop new games themselves. Wide spread of teaching material such as books, magazines, printed codes and many others helped to promote game development among users. Not only new development and teaching tools were promoted, but also game storage and distribution tools, for example, disks, cassette types and cartridges.

Graphical design of a game wasn’t important till 1980s, but the situation has changed since the PLATO system was developed by the University of Illinois. This system was able to
support significant number of users at the same time. PLATO terminals were installed in public computer laboratories and public spaces all over the United States. Those terminals used high quality plasma displays, which attracted game developers’ attention to graphical design. As a results, many multiplayer games with advanced graphical design become popular among players. (Jones, 2015)

Creation of new computers with features made specially for gaming noticeably facilitated game development. Such companies as Apple and Commodore were the first to produce computers more suitable for gaming and game development. Additionally, their active advertising campaigns helped to promote computing and gaming all around the world. Creation of new video and sound facilities took a special place in home computer development. A new model of computer display was created in 1984. It was able to demonstrate 64-colours compared to 16-colores in previous models. In 1989 new sound card was released and set a new standard for computers sound systems.

The development of 3D games with advanced graphics for PC computers began with the release of the Voodoo chipset in 1996. This component supported 3D graphics and was more affordable for home usage. This new feature was immediately applied to first-person shooter (FPS) game genre, and FPS forced 3D game progress for years. (Lilly, 2009)

4.1.3. Online gaming

Online gaming began with the development of Dial-up Bulletin Boards at the end of 1970s. This is a system which allows to share files or messages within a network. (Rouse, 2005) The first network game is considered to be “Snipes”. This game was created to demonstrate the way to connect PC to the local area network in 1981 by the founders of the Novel Inc. This network linked together different personal computers with a purpose to share data. “The Snipes” was a text-mode game, which means that it did not have any graphical interface, however, modern games have a superior design adopted to different computer program. The creation of this game lead to a development of a new game development area – online gaming. A decade later, a new technology was invented, and it allowed to play network games over the internet, and thus spread online games worldwide. Soon after that game development companies began to produce not only network games themselves but also online software to support (distribute, update and other functions) their games. The earliest examples of such software are Steam, Battle.net and WON. (TextModeGames.com, n.d.) By the end of 1990s text-mode games evolved into MMORPG or massively multiplayer online role-playing games, which allowed to play multiple users
within a virtual world. Many of the successful games nowadays are MMORPG, for example “World of Warcraft”.

Unexpected twist has happened after two decades of online gaming popularity. Although games had become very sophisticated and technically complex, suddenly casual simple games boomed the market. The Sims released by Maxis is an example of such casual game. Some of the casual games were embedded within social network sites such as Facebook and Myspace, for example Happy Farm. The latter attracted 23 million gamers per day in China in 2009. (Lukoff, 2009)

In the beginning of 2000s the number of online games players increased dramatically due to wider spread of Internet access all over the world. Also in 2000 online games got huge inflow of new gamers from China due to government’s ban of consoles in the country. This political restriction lead to sharp increase in users’ interest in MMORPGs. (Hook, 2012) MMO and PC games are still play crucial role in game development. According to Global Games Market Report, PC and online games had the biggest share in global game revenue (34% in 2015) till 2016 when mobile games took the second place with $27,1 billion revenue compared to $26,7 billion revenue of PC and MMO games. (Newzoo, 2016)

4.1.4. Video game consoles
The video consoles took its new stage of development after a new type of microchips had been developed. The microchip was small and cheap enough to be used in production of home consoles. These new consoles allowed to play only ball-and-paddle games. Nevertheless, their sales skyrocketed very soon after it had been launched in USA and Europe. Many different companies produced their own versions of home console. However, after several years of success American home consoles market has dropped.

In the beginning of 1980s after market crush game developers were trying to overcome crisis by developing new consoles. The first game stored on ROM-based cartridge was introduced by Fairchild, and other market leaders such as Atari, Magnavox, ColecoVision and Mattel. At the beginning all games for programmable systems for consoles were produced by the same company that created the console itself. But the company named Activision has changed the situation in 1979. Activision was founded by former developers from Atari and it developed many trendy games of that time such as River raid and Pitfall!. Another example of successful spin off company is Imagic, again formed by former developers of Atari. (Poh, n.d.)
1983 was a challenging year for game consoles market in North America. At that moment the market was full of games with low quality, the competition was very high and market leaders (for example, Atari) have failed. Another reason of this crush was that customers’ attention switched from consoles to home computers. Although, the American consoles market crushed, at the same time Japanese market boosted rapidly. (Miller, 2005) As the result a new generation of game consoles was released. That was already third generation and one of the most important feature of this generation is 8-bit processor. Additionally, compared to the previous generations, it had a new gamepad design – Directional-pad with 8 directions. Such companies as Nintendo and Sega became new market leaders and got worldwide success. Games for this generation of consoles became more sophisticated and the production process involved music and motion picture industries. (Poh, n.d.)

In the middle of 1990s many consoles such as Sega Saturn, Play Station and Nintendo 64 began to support 3D graphics. Also due to decrease in popularity of arcade games, many console games started to use new features to become more realistic, such as joystick and pedals imitating real aircraft or vehicle controls. (Poh, n.d.)

The first handheld console with interchangeable cartridges was released in 1979 by Microvision and in the following year Nintendo produces Game and Watch series of handheld games, which included “Tetris” – on of the best selling games of all time. Ten years later, in 1989 Nintendo introduced to the public a new handheld game console in Japan - Game Boy, which soon got worldwide popularity. (Nintendo, n.d.) The idea of pocket size consoles became popular and soon many other companies tried to produce similar consoles such as Sega and Atari. However, because of low capacity level of battery it took years before handheld consoles became as trendy as other consoles.

Fourth generation of consoles appeared in 1987 with production of TurboGrafx-16 with 16-bit processor by NEC in Japan. It found success in Japan, but failed in North America and Europe due to lack of games. Immediately market leaders such as Nintendo and Sega released its own 16-bit consoles. One more feature of this generation is that games are stored on CD discs rather than on cartridges, thus, these consoles had CD-ROM drive. (Miller, 2005)

The next generation of consoles evolve with development of more and more advanced processors. (Miller, 2005) In 1996 Nintendo presented to public new consoles with 64-bit processor. But Nintendo 64 was still using cartridges instead of CD disc for game storage
which resulted in failed competition with other 64-bit consoles. Concerning popular games of this time, music video game genre became quite popular with games like “PaRappa the Rapper” and “Dance Dance Revolution” and many others. Different kinds of shooters were popular as well, because developed graphics made these games more realistic and attractive to players. To sum up, the fifths generation of consoles is the first full 3D generation, finally implementing this technology in almost every game. Also it made a major step towards using CD disc as a way of storing games. (Miller, 2005)

Two years after Nintendo presented 64-bit consoles, Sega released first consoles with built-in modem with Internet access. This important feature of the sixth consoles generation finally allowed to play online games on consoles. Another feature of sixth generation consoles presented by Sega is a DVD-disc game storage. It allows to play games with advanced graphical design and also use consoles as DVD player, thus it is a full home entertainment center. In 2001 Microsoft released first consoles Xbox and immediately started to develop games for it. This consoles supported games for PC and online games as well. In the same year some changes had happened to gameplay as well, a non-linear gameplay became trendy and common among developers. (Miller, 2005)

Seventh generation of consoles can be characterized by high-definition graphics via HDMI, larger storage and support of online games. Examples of this generation are Xbox 360 produced by Microsoft and PlayStation 3 by Sony. Nintendo released new consoles Wii with lower technical characteristics, but lower retail price, which helped to overcome competitors and became a best seller of Nintendo. (Miller, 2005)

Eighth and most current generation of consoles is presented by products of Sony, Microsoft and Nintendo. The latter released Nintendo 3SD in 2011 which can produce 3D effect on the screen and Wii U which has HD graphics, touch screen as a controller and can be used even without TV set. Sony represents itself with PlayStation Vita with multi touch front screen and touchpad, 3G and Wi-Fi support and PlayStation 4 with x86 architecture which is used in many PC nowadays. Xbox One has been released by Microsoft in 2013 as all in one entertainment center, because it can be used not only for games but also as a digital media player. It also has x86 architecture and game controller with impulse triggers. (Miller, 2005)
Now game consoles still represent quite an important area of game development. As stated in the Global Game Market Report 2016, 29% share of global game revenue correspond to TV/console games and 2% of revenue belongs to handhelds, which put it on the third place after mobile and PC/online games. (Newzoo, 2016) Figure 4 shows sales of consoles from 2008 till 2015. As we can see, this market is mostly divided between three companies – Nintendo, Sony and Microsoft.

4.1.5. Mobile phone games

Figure 4. Console sales Worldwide (in millions)

Figure 5. Total Mobile Game Revenue ($Bn) (Newzoo, 2016)
The development of mobile phone games market began in 1997 when Nokia presented new phone which had among other programs a game named "Snake". First mobile games were simple with monochrome graphics and mostly arcade-style. Mobile game market flourished in North America, Europe and Japan in the beginning of 2000s. (Wright, 2016)

Table 4. Mobile Game Revenue 2015 by Countries (Newzoo, 2015)

<table>
<thead>
<tr>
<th>Country</th>
<th>Mobile Game Revenue 2015($M)</th>
<th>Share of Global Revenue</th>
<th>2014-2015 Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>$6,530</td>
<td>21,7 %</td>
<td>46,5 %</td>
</tr>
<tr>
<td>Japan</td>
<td>$6,180</td>
<td>20,6 %</td>
<td>5,8 %</td>
</tr>
<tr>
<td>USA</td>
<td>$6,020</td>
<td>20,1 %</td>
<td>15,2 %</td>
</tr>
<tr>
<td>South Korea</td>
<td>$1,850</td>
<td>6,2 %</td>
<td>8,7 %</td>
</tr>
<tr>
<td>UK</td>
<td>$1,010</td>
<td>3,4 %</td>
<td>11,3 %</td>
</tr>
<tr>
<td>Germany</td>
<td>$820</td>
<td>2,7 %</td>
<td>12,7 %</td>
</tr>
<tr>
<td>France</td>
<td>$520</td>
<td>1,7 %</td>
<td>10,9 %</td>
</tr>
<tr>
<td>Australia</td>
<td>$520</td>
<td>1,7 %</td>
<td>10,8 %</td>
</tr>
<tr>
<td>Canada</td>
<td>$510</td>
<td>1,7 %</td>
<td>13,5 %</td>
</tr>
<tr>
<td>Taiwan</td>
<td>$480</td>
<td>1,6 %</td>
<td>51,2 %</td>
</tr>
</tbody>
</table>

In 2003 Nokia released N-Gage, mobile phone and handheld platform in one device. The product wasn’t successful, however, it opened new perspectives for game development. Already in 2005 Nokia released smartphones N-Series and in 2007 Apple produced the first iPhone reducing the technological gap between PC and mobile phones. Soon after that, both Apple and Google opened app stores, which made access to mobile games much easier.
easier. It also made easier access to the market for small game development companies and individual developers from different countries. (Wright, 2016)

Mobile games have the shortest history compared to consoles and PC games, however, this area of game development has the fastest growth. According to Global Game Market Report, in 2016 for the first time revenue of mobile games overcome the revenue of PC games with $36,9 billion which is 37% of total revenue. Figure 5 demonstrates total mobile game revenue for the period 2013-2016. As we can see on this graph, the total revenue for mobile games has doubled during 4 years. Since the mobile game development has the biggest share of game development market and the technical progress is now driven by this area, we will look closer at mobile development market.

Figure 6 and Table 4 show distribution of mobile game revenue by companies and by countries accordingly. As we can see in Figure 6, the absolute mobile games market leader is Chinese company Tencent. With no doubt, Asian market is now playing paramount role in game development. In 2016 58% of annual growth of global games market came from Asian-Pacific region. The second place is taken by Activison Blizzard King, which increased its revenues due to successful acquisition of King in the beginning of 2016. (Newzoo, 2016) The situation in geography of game development has changed from 1980s and 1990s, when the market was mostly formed by USA, Japan and Europe. Now 60% of the market is shared between China, Japan and USA. Moreover, China showed a fast growth with 46,5% per year.

4.2. Global Game market overview

![Figure 7. Global Games Market revenue by Segments 2016 (Newzoo, 2016)](image-url)
Mobile game market represents the biggest share of the global market, however, it is roughly one third of the games market and it is still important to have a closer look to the whole game market. Figure 7 shows global games market revenue by segments. As it was mentioned earlier in this Chapter, 37% of market share corresponds to mobile game industry with 27% for smartphones and 10% for tablets. (Newzoo, 2016) Only in 2016 mobile game segment reached the first place, in 2015 it was the second. Mobile game development has a high potential since it is the fastest growing area of game industry. Smartphones have a relatively smaller prices compared to consoles for example, there are well-developed markets with billions of users where games could be sold over the Internet (Appstore and Google Play market for example). In other words, mobile games are more reachable for average users than any other type of games and that is how a fast growth of the industry can be explained. The second place goes to PC and online games with 32% (27% PC/MMO and 5% casual webgames). And the third place is taken by consoles with 29% for TV/consoles and 2% for handheld. (Newzoo, 2016)

Table 5. Global Game Revenue by Countries 2016 (Newzoo, 2016)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Population (M)</th>
<th>Internet users (M)</th>
<th>Total Revenue (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>1382,3</td>
<td>788,8</td>
<td>$24 368,8</td>
</tr>
<tr>
<td>2</td>
<td>USA</td>
<td>324,1</td>
<td>293,6</td>
<td>$23 598,4</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>126,3</td>
<td>117,6</td>
<td>$12 447,6</td>
</tr>
<tr>
<td>4</td>
<td>South Korea</td>
<td>50,5</td>
<td>44,6</td>
<td>$4 047,3</td>
</tr>
<tr>
<td>5</td>
<td>Germany</td>
<td>80,7</td>
<td>72,4</td>
<td>$4 018,7</td>
</tr>
<tr>
<td>6</td>
<td>UK</td>
<td>65,1</td>
<td>61,1</td>
<td>$3 830,2</td>
</tr>
<tr>
<td>7</td>
<td>France</td>
<td>64,7</td>
<td>56,7</td>
<td>$2 737,9</td>
</tr>
<tr>
<td>8</td>
<td>Spain</td>
<td>46,1</td>
<td>37,6</td>
<td>$1 812,0</td>
</tr>
<tr>
<td>9</td>
<td>Canada</td>
<td>36,3</td>
<td>32,8</td>
<td>$1 792,2</td>
</tr>
<tr>
<td>10</td>
<td>Italy</td>
<td>59,8</td>
<td>41,3</td>
<td>$1 742,1</td>
</tr>
<tr>
<td>11</td>
<td>Russia</td>
<td>143,4</td>
<td>110,1</td>
<td>$1 414,4</td>
</tr>
<tr>
<td>12</td>
<td>Brazil</td>
<td>209,6</td>
<td>136,4</td>
<td>$1 274,8</td>
</tr>
<tr>
<td>13</td>
<td>Australia</td>
<td>24,3</td>
<td>21,5</td>
<td>$1 199,7</td>
</tr>
<tr>
<td>14</td>
<td>Mexico</td>
<td>128,6</td>
<td>67</td>
<td>$1 125,8</td>
</tr>
<tr>
<td>15</td>
<td>Taiwan</td>
<td>24</td>
<td>21,1</td>
<td>$987,8</td>
</tr>
<tr>
<td>16</td>
<td>Turkey</td>
<td>79,6</td>
<td>46,8</td>
<td>$755,5</td>
</tr>
<tr>
<td>17</td>
<td>Indonesia</td>
<td>260,6</td>
<td>56,7</td>
<td>$704,4</td>
</tr>
<tr>
<td>18</td>
<td>Malaysia</td>
<td>30,8</td>
<td>22,8</td>
<td>$539,5</td>
</tr>
<tr>
<td>19</td>
<td>Netherlands</td>
<td>17</td>
<td>16,1</td>
<td>$521,3</td>
</tr>
<tr>
<td>20</td>
<td>Thailand</td>
<td>68,1</td>
<td>28,7</td>
<td>$521,3</td>
</tr>
</tbody>
</table>
Table 5 demonstrated top 20 countries by game revenue in 2016. As we can see for the whole market the situation is slightly different compared to mobile market. China is still on the first place with $24,4 billion, which is 24,5% of the total revenue in 2016. The second place is taken by US with 23,5% of global market revenue and on the third place is Japan with 12,5% of the total revenue. (Newzoo, 2016) The difference between the third and the fourth place is colossal and the revenue of Japan is almost tree times bigger than that of South Korea.

Looking at the global game revenue in 2016 by region, we can see that 47% corresponds to Asian-Pacific region, 25% to North America, 25% to Europe, Middle East and Africa and only 4% to Latin America. (Newzoo, 2016) Possible reasons of such picture could be population distribution around the world and access to the Internet.

4.3. M&A in the game industry
The history of video game industry development showed that it is a very dynamic field of business, and many former market leaders have disappeared from the landscape of the global game production. The technological progress strengthened the competition and forced the industry to start acquiring more. Since the industry has grown and increased its revenue, it started to attract companies from other industries intending to do M&A. The number of mergers and acquisitions in the gaming industry and the average deal size increased dramatically for the last two years. (Venture Beat 2014) Among multiple acquisitions in the game industry, there were several with a deal value over $1 billion and all of them have happened recently over last several years. Next three examples of such deals will be presented.

• Activision Blizzard - King
The most expensive deal happened in February 2016 when Activision Blizzard bought King for $5,9 billion. It is too early to fairly assess this acquisition, but according to Activision Blizzard (Activision Blizzard, Inc., 2016) Q2 2016 results report, yearly revenue growth is up to 50% and the company reached its new record with nearly 500 million monthly active users. It could be explained by wise acquisition planning. (Lunden, 2016)

Activision Blizzard is one of the largest gaming company in the world with headquarter in Santa Monica, USA. In Activision Blizzard portfolio there are such games as the world’s most successful PC game World of Warcraft, the world's most successful console game franchise Call of Duty and over 1000 other game titles. With acquiring King, Activision
Blizzard gained two of the top-five mobile games with highest revenue in the USA – Candy Crush Saga and Candy Crush Soda Saga. (Activision Blizzard, Inc., 2016)

Before acquisition King developed mostly social games for the web, mobile and Facebook. It was founded in 2003 and filed for an IPO in 2014 with share price $22,50. But by the time of IPO the company was matured and close to the end of its game popularity with no alternatives to the Candy Crush. As the result, Activision Blizzard paid $18 per share. It is early to say how successful was this acquisition, but it seams to be very lucrative. (Lunden, 2016)

• **Microsoft - Mojang**

The second biggest deal is acquisition of Mojang by Microsoft with a deal price $2,5 billion in September 2014. (Wharton School of the University of Pennsylvania, 2014) Microsoft was founded in 1975 as a software company. The company has a revenue of more than 85 billion dollars and 114000 employees as of 2016. Microsoft has Microsoft Studios division. It produced such famous games as Age of Empires, Halo and perform developments of Xbox consoles. (Sarkar, 2014)

Mojang was founded in 2009 and created second best selling video game of all times Minecraft. (Game Central, 2014) This game can be played on Xbox and is supported by both iOS and Android. Microsoft’s CEO explained the reasons behind this acquisition as expectations to boost company’s mobile efforts and strengthen its position in video games. Also the acquisition gives Microsoft a unique vantage point in terms of extremely popular title and its further expansion, as well as access to Minecraft young audience. (Wharton School of the University of Pennsylvania, 2014)

The deal value seemed to be reasonable compared with other Microsoft’s acquisitions, for example $9,5 billion was paid for Nokia. At the time of acquisition Mojang’s revenue was about $290 million annually, where approximately $100 million came from Minecraft. Moreover, before the acquisition both companies had a chance to know each other better, because they worked closely since 2012. (Sarkar, 2014)

• **Facebook – Oculus VR**

The third biggest deal is acquisition of Oculus VR by Facebook in March 2014. The total sum of the deal was $2 billion, particularly, $400 million in cash, 23.1 million Facebook shares and $300 million if Oculus VR reaches certain milestones. (Dredge, 2014) Oculus
VR is an American company founded in 2012 and developing technologies and games for virtual reality. Facebook was founded in 2004 with headquarters in Menlo Park, CA, USA. Currently it is the largest social network in the world with 1.13 billion daily active users. The company had a revenue of more than 17.9 billion dollars in 2015. (Facebook, 2016)

According to Facebook’s CEO Marc Zuckerberg, it is a long-term strategic bet on the future for social networking. He also sees the development of Oculus VR as not only virtual reality games but a tool for communication, for example online studying and doctor appointment. (Dredge, 2014) Although there were debates about this acquisition in tech world, from Oculus VR’s team point of view, it is a positive change, because it will bring new opportunities, reduce risks, allow publish more made for VR content and focus on company’s goals. (Dredge, 2014)

Virtual reality is a new area of game development and it is hard to predict how long it will take till it becomes a complete participant of a global games market. (Dredge, 2014) Now only few companies except Oculus VR are working on this problem. Sony announced its own Project Morpheus VR headset for PlayStation 4 in 2015 and HTC launched smartphones HTC Vive with VR in 2016. Many other big companies revealed their interest in virtual reality games, such as Microsoft and Valve. (Lang, 2016)

Because of a low entry barriers many new game publishing companies appear on the market every day as well as new games, struggling to reach break-even point. About 19000 games were released in January 2016. (Statista, 2016) Most possible future for these publishers is either to be acquired or leave the market, because of high competition. (McCafferty&Company, 2015)

Also since the game technology developing and the competition is enormously high, the costs of game production increase. For developers of large size games, it became more profitable to acquire small potential companies rather than develop games from the beginning to the end by themselves. (McCafferty&Company 2015) An amount of media consumption though video games increased over last years. (Arrington, 2010) Because of that large media companies tend to acquire games to increase intellectual properties and diversify business. For example, Disney acquired social game development company Playdom with a deal of $762 million and Warner Bros. Home Entertainment bought “Rocksteady and Studios” and “Midway Games”. (Warner Bros. Home Entertaiment Group, 2010)
As we can see from the examples above, currently M&A in video game industry has the following trends:

- increasing deal size;
- long-term goals of acquisition;
- companies have a tendency to diversify their games portfolio and fortify their positions on the market rather than reducing competition.

In this chapter the video game industry and its development over the time have been described. The industry had been actively developing since 1970s and it has recently reached the state when M&A became a common tool for company growth. The following tendencies can be seen in the industry:

- It is a global market with high revenue and large audience. It has high potential, attracting attention of companies from other industries;
- Fast technological progress and changes of leading technologies forced companies to react fast and be more aggressive;
- Very high competition and low barriers to entry lead to frequent changes of market leaders.

As a result of these trends, the number of mergers and acquisition has increased remarkably. Acquisitions themselves have become more strategic and require thorough preparation. Because of the increased size of deals, large number of involved employees, and enormously high costs of acquisition as many of the possible outcomes of acquisitions as possible need to be meticulously examined. In this vein, the next chapter presents some opinions gathered from context experts about M&A in the game industry. Their answers will shed light on the current situation on the market.
5. EXPLANATORY INTERVIEWS WITH VIDEO GAME INDUSTRY EXPERTS

This section will investigate factors that affect acquisitions in game industry and what might attract acquiring company in potential target. Game development industry differs from other areas of business and therefore has its own specific features. These features have impact on all business activities and on mergers and acquisitions in particular. Thus, in order to develop algorithm that reflects video game industry specific qualities and possible scenarios of acquisition, we appeal to experts from game industry and ask them question that would help us clarify the situation with M&A in the industry.

5.1. Methodology

To conduct the present study, the primary data was collected. Personal interviews were performed to obtain necessarily information. A semi-structured form of interview with open questions was used for this purpose. Below the fundamental theory of this method is presented.

Semi-structured interview or guided interview is one of the most commonly used types of interview. During semi-structured interview interviewer has a list of predetermined questions as well as during structured interview, but is free to clarify any answers. It also allows to answer to both “what” and “how” questions. (Eriksson & A., 2008) The predetermined list of questions allows to collect the same data and to structure the interview. The main advantage of this type of interview is that while the tone of interview is informal and conversational, the materials are systematic and comprehensive to some extent. (Bryman & Bell, 2015)

Skilled and experienced interviewer is the essential element for the successful results, because he or she should control that all important questions are answered, but at the same time should let the participants discuss the topics freely. The main challenge is to compare the empirical data, because the participants may interpreter the same questions differently. But this challenge might be eliminated, because such kind of interview creates mutual understanding, makes it possible to discuss a topic in detail and in-depth. (Eriksson & A., 2008)

5.2. Respondents

Table 6 contains information about respondents. All six respondents are from video game development industry, however, they are from different professional fields: game development, game design, management, customer experience, human resources. All
respondents have working experience in both mononational and multinational companies in different countries such as the United Kingdom, Republic of Ireland, Spain, Germany, Russia. Thus, obtained results are not biased towards particular country or culture. On the contrary these findings should be relevant to any modern international company.

Table 6. Respondents information

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Title and Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kseniia Aksenova</td>
<td>Senior Customer Service Representative at Activision Blizzard</td>
</tr>
<tr>
<td>2</td>
<td>David Galeano</td>
<td>Former game developer at Criterion Games (was acquired by Electronic Arts) and also owner of a game development company;</td>
</tr>
<tr>
<td>3</td>
<td>Natalia Lapshina</td>
<td>HR manager at Russian top publisher Social Quantum</td>
</tr>
<tr>
<td>4</td>
<td>Alexey Polushin</td>
<td>Game developer at Galapagos (develops games for many top publishers, e.g. Deemedya)</td>
</tr>
<tr>
<td>5</td>
<td>Dmitri Vasilik</td>
<td>Former game developer at HORIS Ltd and Poged GmbH</td>
</tr>
<tr>
<td>6</td>
<td>Anonymous game designer</td>
<td>Game designer at Lionhead (acquired by Microsoft)</td>
</tr>
</tbody>
</table>

5.3. Interview questions

The questionnaire used contains five questions about game development companies’ assets and acquisition procedure. The full list of the questions can be found in Appendix 1. The questions are aiming to help answering to research question and developing a valuation tool that is able to accurately value target companies in the video game industry.

The first question is targeted to discover the most valuable game development company’s assets. The respondents were asked to rate them from most important to less important. The idea of this question is to find out possible attractions for acquiring company, that will form possible acquisition scenarios and thus explain the motives of it.

The second question asks about factors that influence game development company success and also factors that makes its product successful if they are different. The aim of this question is to find out any other valuable assets, that might not be mentioned in the previous question.
The third question is aiming to detect possible reasons of acquisition in video game industry. These reasons might be related to possible valuable assets and they may give insights on what scenarios arise during acquisition in game industry.

The first three questions are designed to receive information about possible parameters of valuation model, since the game industry might differ from other business areas. Acquiring company might have multiple motives for acquisition and it is a very complex task to predict all of them, thus this research will concentrate only on the most plausible reasons, and the others would be left out of the scope of the research. As it was described in the theoretical background section, the most plausible reasons of acquisition, according to Trautwein, are explained by valuation, empire-building, and process theories and the second most plausible are explained by efficiency and monopoly theories. But we need to investigate if it is relevant to the video game industry. Therefore, first three questions are modelled to verify this evidence. (Trautwein, 1990)

The fourth question arises a topic of successful acquisition, namely in what circumstances this process becomes fortunate. This question will help to support research and to get in-depth understanding of how to construct successful decision-making algorithm.

The last question is devoted to corporate cultural distance between acquiring and target companies. The aim is to understand if this is an important issue before selecting a target company. Corporate distance might affect not only the success of M&A, but for public companies it might affect company’s market value. Companies with large corporate cultural distance on average have lower market returns around the acquisition announcement period. As the results synergy value is less than expected from the merged firm. Thus, the importance of including of corporate culture in the target company valuation needs to be explored. (Alexandridis, et al., 2016)

5.4. Results
In this subsection the summary of respondents answers will be presented.

**Question 1: What are the most valuable and important assets of a game development company?**

The answers to this question are divided into two groups – one group thinks that the rights to popular franchise is the most valuable asset of game development company, the other group believes that companies employees are the ones who make the most value for the company.
One of the respondents commented on popular franchise answer: “Game development is very risky and uncertain. If you have already developed a successful game, that would make your company very attractive to potential investors, developing a sequel is always considered less risky”. Some of the respondents mentioned not only franchise, but all intangible assets, for example, recognizable game titles (e.g. Angry Birds), characters (Lara Croft) or game studio style (Telltale Games).

One of the respondents made an example of most valuable roles for the game company. According to this respondent game designers, game development & QA, IT, game support and marketing are key business functions for the game development. Other respondents believe that right people at the head of the company lead to success. Another popular answer is that marketing is quite a valuable asset, because it brings popularity and brand recognition. The rest of the answers were mentioned only once, but brought bright ideas about game industry’s important assets.

Good internal tools or a productive development process might also be very valuable for the company. “The majority of the initial work when developing a team goes into creating the tools and pipelines needed to bring content into the game, and often the results are not good enough and everything has to be started again almost from the scratch. Buying a company that already has a good content creation and delivery process could save a lot of money and time.”

Another valuable asset is company's corporate culture. It helps teams to enrich and define their work dynamics and interactions with each other. Without doubts corporate culture and team’s identity as a group are valuable assets. They affect teams’ productivity and in some sense are related to top answer – “company employees”.

The ability to keep a high level of respect and fidelity to your public but without betraying your identity and creative principles is very important for game development company as well as the capability to innovate or elaborate new products and to be prepared to new challenges. As an opposite side of that is users’ loyalty comes of.

Percentage of respondents mentioned particular asset as valuable in Question is demonstrated by Figure 8. Absolutely all respondents at least once mentioned company employees as a valuable asset without considering its rank. Popular franchise has been noted by 50% of respondents. 33% of respondents named marketing as a valuable asset.
Productive development process, corporate culture and respect to public was mentioned by 17% of respondents.

![Figure 8. Percentage of respondents mentioned asset as valuable in Question 1](image)

Table 7 shows respondents' answers ranking, based on their own valuation. As it was told earlier the first place is split between employees and popular franchise, the second between employees and marketing, and the last corresponds to corporate culture, productive process and respect to public.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company's Asset</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Employees/Franchise</td>
</tr>
<tr>
<td>2</td>
<td>Employees/Marketing</td>
</tr>
<tr>
<td>3</td>
<td>Corporate culture/Productive process/Respect to public</td>
</tr>
</tbody>
</table>

**Question 2:** _What makes game development company successful and what makes its product successful?_

At first, the qualities that bring success to the company were discussed. Figure 9 demonstrates possible conditions which constitute the success of a game development company. The most common answer is that the company should deeply understand the
game market and be ready for any changes, for example, new game trends or business scenarios. In such a rapid changing industry it is critical to catch a wave. The other key to success is to deliver the highest possible quality of the product. With no doubt, this is of paramount importance to success.

Figure 9. The conditions of a game development company success according to the experts.

An appropriate business model has a significant influence on a company success. It means the right choice of specialization and strategy for game development. The company needs to find its own audience. For example, the strategy of long-term projects, which will be interesting for gamers for longer, rather than short-term projects, which can maintain gamers’ interest only for a short period of time. It is also important to think over platforms and game delivery network; in other words, the way gamers will get access to the game. If we are talking about financial success, then an important role is played by game monetization schemes and wise management of company finance.

Company’s employees take a crucial role in its success. Their skills, quality of management and communication inside team are vital to high quality product. Company culture and vision complement employees’ talents and affects productivity.

An important topic about success was raised by one of the respondents. He pointed out that metrics of success can vary depending on who you ask: the investors, the industry, or the game players. “There are successful games that did not make much money but created
whole new game genres that advanced the game industry forward, or games critically acclaimed that few people played." Piracy is also a serious issue for company success. “Great games may have not sold enough because they were easily available for "free". Some game companies survive more for the technology they create than whether their games are good or not”.

![The game is successful if](image)

Figure 10. *The conditions of a game’s success according to the experts.*

Figure 10 shows the conditions of a game’s success. Based on respondent’s opinion a game can be considered successful if:

- it sells a lot;
- it earns enough to survive;
- it is critically acclaimed.

Financial success is very disputable, because a high production costs, competition and piracy can make even a successful game unprofitable. “A majority of game companies do not make any profit, most made just enough to keep paying salaries to develop the next game.”

The qualities that bring success to a product differ from the ones for a company. However, some of the respondents mentioned that if a product successful, then a company is successful as well. Generally, all the respondents were speaking about different characteristics of a product quality. Wise marketing campaign together with product recognition and product quality are paramount for success. One of the respondents
commented on that: “Unfortunately I have seen many cases of well known brands being dragged on the ground by poorly executed products, sometimes due to impossible-to-achieve deadlines. I have also seen, on the other hand, some extremely good quality products failing due to lack of visibility or proper marketing support.”

Uniqueness of the game is influential, both of scenario and technical part. For instance, a new way of interaction with game objects or main character such as Doodle Jump based on smartphone accelerometer. However, there are many examples when the sequel of a successful game became as much popular as the original. Often a game became successful when it supported another successful brand (for example, movie or book).

**Question 3: What might be possible reasons for a company in this industry to make an acquisition?**

According to experts' opinions, the reasons are the following:

- **To get access to successful franchise** with all formal rights to use it, so that acquirer can make a sequel for example.

- **To improve technical base**: new engine, IO devices, patents.

- **Talent acquisition**, meaning to get access to acquired company’s developers who know the franchise.

- **To reduce competition** and enforce acquirer’s product positions. There is no need to develop a better product if it is possible just to buy the competitor.

- **To fill gaps in acquirer’s catalogue**. The reason for that might be desire to present a more interesting front to investors, or to improve company's public image.

- **To reduce time to market**. Developing a game is risky and time consuming, buying an already productive company could significantly reduce the time to market for acquiring company.

- **To improve tools and pipelines** for all acquirer’s other existing teams. “Maybe you have several games in development but your tools and processes are not good enough, and you hope to improve all your different development teams at once by incorporating better tools from someone else”.

- **To get access to famous brand**. Brand association of acquired company can help acquiring company to reach commercial success of their brand new game console for example.

- **Expanding the network of locations, audience, platforms and the business**. For example, Activision Blizzard bought King, because it had huge audience on mobile platforms and stable income from micro-transactions.
**Question 4:** *What factors are important for a successful acquisition and what makes this acquisition successful?*

This question was quite challenging for these respondents that were not been involved in an acquisition process, however, the one who went through a company acquisition has a clear sole opinion about its success. The factors named by experts are presented in Figure 11.

One important opinion is that goals and possible outcomes of the deal should be clear in advance. Acquisition should be well planned, well agreed and clear in vision. Another popular idea is that the success of acquisition depends on whether the different teams forming your organization can effectively work together. “It is totally possible for everyone to hate each other and still make a lot of money, but the odds are significantly lower. In many cases the integration problems are due to individual egos, either developers do not want to work with other developers, they refuse to use someone else's tools, they refuse to give up their parcels of power, etc.”

![Diagram of M&A success factors]

*Figure 11. Factors leading the success of M&A according to the experts.*

The integration should be well done not only for team, but also for product. Finding the right place for the acquired company products in own product line is very important for success. Also an extremely important factor of success for any prospective buyer is the capability to understand and respect the identity and culture of the company they are buying. Developing a certain level of flexibility and adaptation to a new scenario by acquired company is always
a key to successful acquisition. Flexibility means also an ability to adapt to each other's quirks and work dynamics. Finding a right target company is also a key to success, the acquirer should be able to manage the acquiring procedure. It means that the acquirer should think through all the procedure and have enough sources to make the acquisition work. The goal should be achievable.

**Question 5:** Is a cultural difference between acquiring and acquired company influence the success of the acquisition? How important is the "identity" of the acquiring company to the company being acquired?

The answers were divided into tree groups. Those groups are presented in Figure 12. The first group believes that company’s culture doesn’t matter because the video game development world speaks the same language, or it might matter, but only prior to acquisition. For instance, the owners might decide not to sell the company, because they do not trust or do not like the potential buyers. However, “if the acquisition went ahead, it is up to the personal egos of people in positions of power whether an acquisition works or not”. Culture doesn’t affect a success of an acquisition. Companies might have totally different cultures, but employees still can respect and understand each others’ differences and work productively together.

The second group thinks that cultural issues might and might not affect an acquisition depending on the agreement of acquisition. For example, if an acquiring company wants to merge teams together, cultural differences might disturb both ways. However, if after acquisition companies continue work on their own, they preserve their own culture and values. Cultural issues do not affect success of such acquisitions. Corporate cultural also could rely on acquiring company actions, because it “dictates the rules”, but acquiring company also responsible for finding a place for acquired developers in company’s team. Managers of acquiring company need to “find a common ground with their new co-workers and work efficiently in a new environment”.

The third group believes that cultural differences do matter for the results of acquisition. The acquiring and target companies might have different corporate cultures, for example, different decision-making and leadership style, attitude to the work and working relationships. “And if these cultural differences are major and top-management doesn’t see it then the success of an acquisition is in question.” Diametrically opposed companies’ backgrounds, sensibilities or perspectives on how to develop a product might lead to a failure of an acquisition. Becoming a part of a larger organization is always going to be tricky
and in some degree a “cultural shock” is likely to happen. But developing the ability to recognize potentially “toxic partnerships” should be the key for a successful acquisition.

![Diagram]

**Figure 12. Respondents answers to the fifth question.**

One of the respondents provided examples when cultural issues were not treated in the correct manner. In the first case, which the respondent called the "Elephant in a china shop", a highly powerful but risk-adverse organization is buying an independent "free spirited" studio. The likely outcome will be that soon after being acquired, the studio will get a previously motivated team shaken to its foundations to fit to monolithic, precise, and infallible work model of the acquiring company. As a result of this maladjustment of cultures, any member of the team being considered "unruly" (dissenting or assertive) will find themselves at risk of being "let go". The overall effect of this will be catastrophic. It will affect the quality of the final product, hurt the brand and result in poor sales and reviews.

The second scenario was called by the respondent the "Welcome to the gravy train". In this case “a daring "Rock Star", for example, a group of developers bought by an organization who is careless enough to think that massive amounts of money and no supervision will make for an outstanding product“. Right after acquisition and due to a new found sense of self entitlement this group of talented individuals will feel too safe and relaxed, lowering their standards of work and even betraying their identity in the process. As a result of this, the overall quality of their product will suffer, hurting company’s brand and resulting in poor sales and reviews in the process. According to the respondent, although these scenarios look extreme they are unfortunately quite common in the game industry.
5.5. Results discussion

The first question gave us a list of most valuable and desirable assets in a game company. The idea of company product to be its most valuable asset seems very reasonable and logical. An exploitable franchise, which has a lot of users is an attractive goal for potential acquirers. It is possible to develop sequel, which is less risky than developing new game. Also a recognizable game title can be used for production of any other kind of products. For example, game company Rovio opened an activity park based on the “Angry Birds” game. (Rovio Entertainment Ltd, 2016)

With no doubts, the people that make the product are extremely valuable for the company. These are the people who bring ideas, passion, quality to the company. The employees should work well as a team, they should be experienced, creative and productive. Building a good development team is complicated and time consuming, acquiring a whole team is an easy solution and reduces the risks of creating you new team. About 70% of the top managers leave the organization within five years after the acquisition. (Walsh & Ellwood, 1991) Therefore, it is important to perform an acquisition in a way that the key employees will be interested to continue their work in the company and the investments in this acquisition will pay off.

Marketing is a valuable asset in some sense related to both - employees as talented marketing specialists and successful game as a recognizable brand. As it was said above famous brand can be used for further investments for instance. Brand equity or brand power represents the amount consumers are willing to pay above a product’s worth to receive the value of the brand and should be reckon in target’s value. (Wasserman, 2015)

Effective tools and productive development process are very valuable, because they might save time and money to the acquiring company, and thus reduce productive costs. Corporate culture might affect productivity and performance of the company. Thus, it should be revised before the acquisition. To sum-up answers to the first question, in the game development industry as in any other field of business the value of a company depends on talented people, high technologies and wise use of resources.

As an answer to the second question, ability to adjust to changes, the best possible quality, well-thought out business model and management skills have been mentioned as qualities that bring success to game development company. These are the qualities that the
acquiring company should pay attention to while choosing between different target companies.

High quality of a game is essential for its success. Well-developed gameplay, game’s world and story, tech stability, game support, outstanding graphics, unique style, universe design and character design are important for success if we are talking about quality characteristics in details. A successful game cannot be created without deep understanding of target audience, for which the game was created. And game can be considered successful if it has high sale and financial payback, recognizable brand by customers and critics.

The respondents answered with nine different reasons for acquisition to the third question, which all fit acquisition motivation theories described in the theoretical background chapter. By applying Trautwein theories that explain acquisition motives to respondents’ responses we can group the answers into two sets. The first set contains reasons of getting access to different assets such as rights to popular franchise, talented employees, technical base, tools, famous brand and others. By accessing these assets, acquiring company could both significantly improve its performance and thus increase revenue and reduced cost required to production of a game. Therefore, this group of reasons suits under efficiency theory, which states that M&A are being planned and executed to archive synergy. (Trautwein, 1990)

The second set contains reasons to diversify business with new types of game, reduce competition and expand to new markets and locations. This group of reasons could be explained by monopoly theory, which assumes that M&A is performed to increase market power. Although in Trautwein study, valuation, process and empire-building theories are stated to have the higher degree of plausibility, based on the experts’ opinion efficiency and monopoly theory are more plausible for the video game industry. Although other motives of M&A might take place in video game industry, we will not proceed with them in this study, because our decision-making algorithm is designed to support rational acquisitions with an aim to maximize company’s revenue and/or increase market share. (Trautwein, 1990)

Answers to the fourth question explained the circumstances when the acquisition could be considered as successful. According to the respondents, the acquisition will be successful if it is well-planned and everything concerning acquisition should be agreed in advance. The acquiring company should know the target company in details, and think through what actions to take after the acquisition. The presented above answers support
the motivation of this research, because as a result it will help to receive more structured target’s valuation and thus prepare better for the acquisition.

The fifth question gives information about corporate culture influence on the M&A. All respondents had different opinions about cultural distance. The controversial responses are supported by Cartwright study of several M&A related researches. According to this study, researches dedicated to relations of culture and performance in a context of M&A give rather mixed and contradictory results. (Cartwright & Schoenberg, 2006) Some of the respondents believe that cultural differences don’t matter, or at least till the acquisition is done, because this is not an issue for video game industry. Some of them think that it is crucial to be aware of possible cultural difficulties, because the cultural differences might affect the results and success of an acquisition. However, it is known that cultural distance between acquiring and target companies might affect their market value negatively. (Alexandridis, et al., 2016) Thus, cultural issues need to reflected in the target valuation algorithm. In this way these cultural issues could be treated well in advance and therefore well-planed acquisition will be more likely successful.
6. BACKGROUND FOR THE DESIGN OF A M&A ANALYSIS TOOL FOR THE VIDEO GAME INDUSTRY

In this chapter the steps of the M&A analysis tool are described. At first, valuable video game company assets will be discussed and their measurements are presented, because their valuation is a part of the algorithm. Then possible acquisitions motives based on the experts’ answers from the previous chapter will be transform into options that need to be valued. The valuation of target company as stand-alone and possible synergies is recounted separately.

6.1. Game development company assets and their valuations

Based on experts’ opinion we can define several important assets that might attract acquiring company. We need to determine what affects each particular asset and how to valuate it, because these assets are components of real options for the algorithm.

First asset: successful product – game franchise

As it was said above, the acquiring company might plan just to get rights to successful product and make a sequel or it might support this game and get profit from it. No matter what the final goal is, this game needs to be evaluated thoroughly and the success of it needs to be estimated. Because many games might be well advertised, but after all they are not profitable, or has no potential since the popularity is climbing down. The question is how to make sure the game we are planning to acquire will be profitable.

The answer is to look at key performance indicators or KPI. Although every company chooses its own indicators, that suit some specific targets, there are commonly used KPI for game industry. Those KPI might help to compare potential targets if acquiring franchise is the goal. Experts of GameAnalytics considered that the future success of a game can be measured even before its release. In a case of acquisition this is very important because target’s portfolio might include such unreleased games and that affects company’s value. (McCalmont, 2015)

First of all, a game monetization plan needs to be assessed. It could be single-payer game when player pays only once when purchase the game or free to play game which might have built-in purchases. Based on that different indicators should be examined. For single-payer game the calculation of profit is straightforward – each user spent the same amount of money. If revenue outweighs costs, then the game is profitable. (McCalmont, 2015)
For free to play game or freemium, the profitability can’t be calculated that easily. The revenue might come from virtual goods – in-game items or game-related services such as power-ups, premium content or subscriptions that upgrade gameplay. Every player spends different amount of money. Thus we can have a look at Conversion rate that measures the percentage of users that made any purchases or payments out of all game’s users. (Lovato, 2015)

Also such indicators as Cost per Acquisition (CPA) or Cost per Install (CPI) can be used. Since many free to play games have to make some advertising campaign to be visual between millions of similar games, thus when downloading every user has some at least virtual costs. It is the cost of acquiring a new user, costs of advertising campaign divided by the number of new game installs. (Lovato, 2015)

Together with another KPI lifetime value (LTV) it is possible to calculate return on investment (ROI) of a game – crucial indicator of game profitability:

\[ ROI = LTV − CPI \]  

(23)

Tracking ROI allows to understand if the game is profitable (the value is positive) or ineffective (the value is negative), which is extremely important when valuing target company.

To explain how to calculate LTV, first we need to introduce several important terms. Monthly Active Users (MAU) is a number of unique users that played a game at least once a month. Daily Active Users is a number of active unique users in a particular day. Average Revenue per User (ARPU) is a game’s revenue divided by number of active users. Also could be useful Average Revenue per Daily Active User (ARPDAU) and Average Revenue per Paying user (ARPPU). Both ARPU and ARPPU are essential indicators of game profitability per user, important to notice that the first indicator will always be lower than the second one. (Xicota, n.d.)

Returning back to LTV, there are several methods to estimate this indicator. The first method is the easiest way to calculate LTV, but it won’t predict future value of LTV, it will show only value post factum. The amount of users, that have already left the game, should be defined, and the total revenue from these users should be divided by their amount. Less accurate method is to divide revenue for a certain period by total number of users for that period. Another method can be used if we know how many days an average active user spends on the game for a certain period or in other worlds users’ lifetime. Then we multiply
the number of days by ARPU. This method allows to calculate LTV for each day and for different user segment. However, calculating number of active days may be confusing and difficult. (Sabirov, 2014)

There is another way to calculate lifetime. To perform these calculations, we need to introduce term Retention rate. It is the amount of users that continued playing a game during specified time period. This rate is one of the most important indicators that demonstrates potential of the game. The more users return to play it again the more users enjoy the game and are potentially willing to pay. It is also possible to calculate Retention rate for different segments of users, which might be helpful analyzing potential customers of such game. (rate => function) The retention function is:

$$F(t) = A + \frac{B}{t+C} \tag{24}$$

Where t is a number of days from user’s first visit, F(t) is future retention equation and A, B and C are model coefficients. (Sabirov, 2014)

Next we need to substitute the known values into the equation and receive a system of equation for A, B and C. Calculate the sum of squared differences between the actual and modelled values of F(t) and then find values of A, B and C minimizing the cumulative deviation. Next step is to calculate integral from the retention function:

$$\int_{T_1}^{T_2} A + \frac{B}{x+C}dx = A(T_2 - T_1) + B(ln|T_2 + C| - ln|T_1 + C|) \tag{25}$$

The right edge of the field of integration will demonstrate period of time for which LTV should be calculated. (Sabirov, 2014) After that we should find discounted future value of revenue using weighted average cost of capital (WACC):

$$PV = \sum_{i=1}^{N} \frac{CF_i}{(1+WACC)^i} \tag{26}$$

where PV is present value, CF$_i$ is Cash Flows in time period $i$. Discounted sum of CF is the game lifetime value, and we can multiply it by ARPU. Alternative method is to use cumulative ARPU. (Sabirov, 2014)

As we mentioned Retention rate it is useful to explain Churn rate or Attrition rate. It is an opposite to Retention rate, meaning that it demonstrates the number of users that have stopped playing the game. Together retention and Churn rates should represent all game’s users. (McCalmont, 2015) All user related KPI are useful to measure target’s potential especially if it uses advertising in monetization strategy. Additionally, it might be useful to look at Sticky factor or DAU/MAU ration, which demonstrates how many monthly users
are playing this game daily. For example, DAU/MAU ratio of social network Facebook is about 50% meanwhile ratio for most successful mobile games is 20%. (Lovato, 2015)

With free to play games sometimes it might be useful to have a look at in-game metrics. It will not affect the value of the target company but it shows the quality of the game and thus its potential to be monetized. In-game metrics means the indicators that will show you on which part of the game users spent the most or where it is not necessary to buy anything, because the game is too easy. Successful game should be well-balanced and challenging enough for gamers. (Xicota, n.d.)

Valuing a game is a troublesome and time consuming process. However, when attention is paid to relevant performance indicators, the value and potential of the game can be roughly estimated. The indicators should be set accordingly to monetization strategy of the game.

Second asset: successful team (talents acquisition)

Besides a popular game, the acquiring company might be attracted by talented team of developers. Finding proper specialists, making a good professional team is very time-consuming and expensive. Acquiring a whole team could be a brilliant solution to these problems.

An obvious way for this scenario to valuate target company costs is to look at costs related to company’s personnel – payroll costs. With no doubts, such costs include basic employee salaries and mandatory complements. It is social security contributions, taxes and other costs included in the basic remuneration and mandatory complements, which vary depending on the country. For game developers in USA the salary may vary from $40000 annually for entry level positions to over $120000 for senior developers and team leads. (Bay, 2016)

Aside from regular salary costs might include different kinds of employee benefits such as:
- health care insurance;
- disability insurance;
- life insurance;
- retirement / pension plans;
- flexible compensation;
- paid vacations, holidays or sick leave.

Potentially personnel's budget might also include costs on:
- selection and placement of new employees or replacement of old ones (for example, recruitment advertising, recruiting agency fees, background check and other costs);
- training and development of employees (external/internal programs, certification exams and others education related costs).

If acquiring company aims to save time and money by buying a complete team, the cost of acquisition might be compared with alternative costs such as recruiting a team from the scratch. In addition to recruiting costs the company will spend time to search for suitable candidates instead of using it to develop new product. Most of the recruiting companies request between 15% and 25% of the candidate’s total first year annual earnings for its services. (The Undercover recruiter, n.d.) The time required to spend looking for IT Specialist in general takes 48 days according to Glassdoor report. (Glassdoor, 2015) Thus, knowing a size of team needed it is easy to predict how much it will cost to hire a new team.

**Third asset: marketing – successful brand**

Building a successful brand is a time-consuming and expensive procedure, especially for innovative products. (Mourdoukoutas, 2014) Acquiring a company with highly recognizable brand saves a lot of money and time. Recognizable game brand can be helpful when company wants to launch a game based on this brand or sequel game. Using famous game title in marketing campaign will help to attract more gamers and help to spread information about it faster. Considering how many new games have been released each month (19000 games in Appstore in January 2016), having a successful marketing campaign is crucial for future sales. (Statista, 2016) Being visible for potential customers is a key to success.

The other potential reason of acquiring a famous game brand is to use it for producing products based on this brand, for example books, films, toys. Many popular games became a basis of films, such as Warcraft, Angry Birds, Lara Croft, Silent Hill and many others. Moreover, merchandise production can be very profitable. For example, 45% of $200 million Rovio (Angry Birds) revenue came from merchandising in 2012. (Rovio, 2012)

There are many ways to measure game brand awareness, but the obvious one is to have a look at number of active users, for example MAU. Additionally, brand recognition can be measured by search volume data, for example with the help of Google trends or social media and networks, for example Facebook statistics. (Smith, 2015)

**Fourth asset: productive development process and tools**
As it was said earlier, game development is a costly and risky business. Having well-organized development process might help save time and money if for example acquiring company wants to try developing games but has no experience. The value of internal tools can be measured through comparing with similar software programs. For instance, Jira software for issue and project tracking costs from $220 annually for teams smaller than 10 people and up to $16000 annually for larger companies with more than 500 employees. (Atlassian, 2016) Github Enterprise software for versioning control costs $21 per month. (GitHub, 2016) Commonly used for game development animation, modelling, simulation and rendering software Maya costs £170 per month and 3D engine “Unreal Engine” requires to pay 5% of all gross revenue after the first $3,000 per game or application per calendar quarter, regardless of what company collects the revenue. (Unreal Engine, 2016) (Autodesk, 2016)

As we can see costs on game development software are relatively small compared to possible employees’ payroll, but still important for production process.

**Fifth asset: corporate culture**

Corporate culture refers to long-established, mostly undeclared, shared values and beliefs that affects employees’ behavior, attitudes, and company’s relationships. (Deloitte Development LLC, 2009) According to report “Cultural issues in mergers and acquisitions”, the following aspects of corporate culture might affect the success of M&A:

- Decision-making style;
- Leadership style;
- Ability to change, meaning readiness to risk in contrast to maintaining current state;
- How people work together, for example formal or informal role definition;
- Beliefs regarding personal “success”, for example, whether company focuses on teamwork or on individual “stars”. (Deloitte Development LLC, 2009)

Even though it is unlikely that the main reason of acquisition is corporate culture, adoption of this asset may improve acquiring company performance and thus revenue. Worth to mention that corporate culture might affect performance in both ways – negative and positive.

It is quite hard to valuate numerically such a complex concept. Several studies tried to measure corporate culture and its effect on M&A. However, all of them are related to post-acquisition phase, for example Alexandris et al. (Alexandridis, et al., 2016) studied impact
of corporate distance on M&A and Fiordelisis and Martelli (Fiordelisi & Martelli, 2011) examined the effect of corporate culture on M&A in banking sector.

Although it is hard to deny the importance of corporate culture on company performance it is still difficult to value it prior to acquisition. Since there is no unique technique to measure it, in this research the valuation of corporate culture impact will be presented as a percentage of revenue.

Some of video game industry professionals mentioned respect to public and customers’ loyalty as an asset. But since customer relationships are affected by corporate culture as well, they will not be studied separately in this research.

**Sixth asset: target company’s tangible assets**

With no doubts, in video game industry’s acquisitions the main attention is paid to target company’s intellectual property. However, tangible assets such as cash, equipment, inventory and properties owed by target company still affect target’s value for acquiring company. For listed companies, information about assets can be easily accessed, but for public limited companies without insider’s information accessing information can be challenging.

6.2. Real options of game development company

Next we examine what possible real options acquiring company has with regard to above mentioned target company’s assets. According to the video game industry experts, the reasons can be divided into two groups based on the Trautwein theories.

- **Monopoly theory group:**
  - Expanding the network of locations, audience, platforms and the business. For example, Activision Blizzard bought King, because the latter had huge audience on mobile platforms and stable income from micro-transactions.
  - To fill gaps in acquirer’s catalogue. The reason for that might be a desire to present a more interesting front to investors, or to improve company’s public image.
  - To reduce competition and enforce acquirer’s product positions. There is no need to develop a better product if it is possible just to buy the competitor.

- **Efficiency theory group:**
  - To get access to successful franchise with all formal rights to use it, so that acquirer can make a sequel for example.
To improve technical base: new game engine, IO devices, patents.

Talent acquisition, meaning to get access to acquired company’s developers who know the franchise.

To reduce time to market. Developing a game is risky and time consuming, buying an already productive company could significantly reduce the time to market for acquiring company.

To improve tools and pipelines for all acquirer’s other existing teams. “Maybe you have several games in development but your tools and processes are not good enough, and you hope to improve all your different development teams at once by incorporating better tools from someone else”.

To get access to famous brand. Brand association of acquired company can help acquiring company to reach commercial success of their brand new game console for example.

The reasons described by monopoly theory can be also called an option to grow the company through acquisition, because:

• Increase the revenue through expanding the network of locations, audience, platforms and the business;
• Diversify and thus reduce risks by filling gaps in the catalogue;
• Increase market share by reducing the competition;

The reasons presented by efficiency theory are parts of the option to create synergies through:

• Increasing revenue:
  o Developing new game based on an old one (rights to successful franchise);
  o Developing new projects based on famous brand;
  o Attracting more talented employees;
  o And also through expanding the network of locations, audience, platforms and the business;

• Reducing costs:
  o Improving technical base;
  o Improving development process and acquiring tools;
  o Reducing time to market.

6.3. Target company valuation algorithm

The structure of the algorithm should reflect these options and thereby we can use the target analysis structure suggested by Collan and Kinnunen (Collan & Kinnunen, 2011) in “A
Procedure for the Rapid Pre-Acquisition Screening of Target Companies Using the Pay-off Method for Real Option Valuation". They modified suggested by Boer company value concept suggesting that there are tree levels of target company value from acquiring company perspective.

Figure 13 demonstrates three different levels of a target company value. The first level represents company’s assets and their current value, in other words economic value. The middle level is the target economic value plus its strategic capital, which means target’s opportunities or real options. The third level is available only for acquiring company, because it represents target’s economic and strategic capital plus synergies. The value of this level depends on the acquiring company strategy, meaning that each different synergy is different real option available to the acquiring company. Thus synergies should be valued as a separate step of a target valuation. (Collan & Kinnunen, 2011) This decision-making algorithm will follow the presented above value concept. A target company will be analysed from two perspectives: as a stand-alone company including both economic and strategic capital and as an opportunity for synergies.

6.3.1. Valuation target company as stand-alone
The first part of the analysis requires information about current state of the target company. This information can be found in financial statement of a target company. However often an acquiring company does not have an access to target company financial statement. In this
case it has to rely on all available information and the ability of decision maker to estimate its value.

To make valuation procedure easier and more visual, inputs sections will be organized to match valuable assets described above. Since not all of the described assets can be valuated in the same manner, some of them will be included in a separate section. For example, analysis of corporate culture will be performed separately, because experts did not have unique opinion about its importance for company valuation.

The analysis starts with the request of the information about total sum of target company values. It might include both tangible and intangible assets, but only those assets that are non-core. Non-core assets are assets that are not essential or not in use in business operations. In other words, they can be easily sold after acquisition without any impact on target company’s revenue. For the game development company, it could be for instance patents, that are no longer in use for game development, domain names, property or equipment.

Since the information about target company can be very imprecise, the uncertainty about inputs can be treated by using three scenarios. These scenarios should contain information about an extremely pessimistic case, extremely optimistic case and most likely case which should be in between of the first two. According to Collan and Kinnunen (Collan & Kinnunen, 2011), the pessimistic and optimistic scenarios need to be really extreme, and managers should chose maximum possible and minimum possible values for them.

Another way to treat uncertainty about future values and make the valuation more realistic gives the ability to chose different interest rates for different assets and different synergy scenarios. Moreover, the algorithm allows to use multiple single-period rates as a discounting factor. The use of a single discount rate could affect the valuation, because it will either overestimate or underestimate the present value of the future cash flows when the market rate conditions are changing. (Tiwari, 1994) However, if the rates remain constant or if they change in a neutralizing fashion, single discount rate could be used for an estimation of the present value of the future net cash flows.

The present value estimated using multiple one period rates \((PV_m)\) is given by the following formula:

\[
PV_m = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} 
\]
\[
PV_m = \frac{c_1}{1+y_1} + \frac{c_2}{(1+y_1)(1+y_2)} + \frac{c_3}{(1+y_1)(1+y_2)(1+y_3)} + \ldots + \frac{c_{n-1}}{(1+y_1)(1+y_2)(1+y_3)\ldots(1+y_n)}
\]
\[
\frac{c_n}{(1+y_1)(1+y_2)(1+y_3)\ldots(1+y_n)},
\]

where \(c_i\), \(i = 1, 2, 3, \ldots n\) is periodic cash flows;
\(Y_i\), \(i = 1, 2, 3, \ldots n\), is one-period multiple rates.

If \(Y\) is an unbiased estimator of the one-period multiple rates \((Y_1, Y_2, \ldots Y_n)\), then: 
\[
PV_v = PV_m. \text{ (Tiwari, 1994)}
\]

The intermediate results of the first step of the analysis are the free cash flows estimated for each of three scenarios and the net present value for each cash flows scenarios.

Free cash Flow demonstrates how much money a company has after it has paid for capital expenditure (building and equipment) and other expenses required to support ongoing operations. There are several ways to calculate free cash flows (FCF):

1. \(FCF = Sales\ Revenue – Operating\ Costs\ and\ Taxes – Net\ Investments\) \text{ in Operating Capital} \quad (28)

Investments in operating capital represents increase in company’s fixed assets.

7. \(FCF = Net\ Operating\ Profit\ After\ Taxes\ (NOPAT) – Net\ Investments\) \text{ in Operating Capital} \quad (29)

Where NOPAT is basically Sales Revenue minus Operating Costs and Taxes

8. \(FCF = Net\ Cash\ Flow\ from\ Operations – Capital\ Expenditures.\) \quad (30)

In this research the first approach of FCF calculations will be used. (Peavler, 2016)

Operating costs refers to maintenance and administrative expenses required to support business on a day-to-day basis. Operating costs usually does not include capital outlay – expenses to acquire, maintain, repair, or upgrade capital assets. Operating expenses may include accounting and legal fees, bank charges, sales and marketing costs, travel expenses, entertainment costs, non-capitalized research and development expenses, rent, salary and wage expenses, repair and maintenance expenses, office supply and other costs.

Since the game development companies have their own specific operation process, thus, operating costs might differ from other areas of business. To simplify this step of analysis for decision-maker, the inputs will be reviewed in details from position of game industry. (Boucher-Vidal, 2014) For game development company operating cost might include the following expenses:

- Production and development costs:
Salaries of developers, designers, marketing and others team members;
Voice acting, music;
Development tools;
Game engines;
Servers hosting / Cloud computing;
Equipment rent;
R&D;

• Marketing and promotions:
  TV/print/online advertisements;
  Events and launch parties;
  Participations in thematic conferences and events;

• Manufacturing and distributions (may vary depending on a game type):
  Manufacturing costs (for arcade machines, optical discs and others)
  Retail distributions;
  Digital distribution (for example, Steam, Appstore). (Dietrich, 2009)

Other expenses could be office rent, legal and accounting fees and others costs important for supporting of production process. Ability to forecast is important not only for stand-alone target value but also for synergies valuation.

The sales revenue from game development company is obviously coming from game sales. If there is no direct access to this information, decision maker can try to find revenue from Number of Active Users multiply multiplied by Average Revenue per User. The number of users can be assumed, for example, from number of downloads of the game or from number of players in game client for online gaming. The Average Revenue per User is hard to guess, but the Pay-off valuation methods allows to overcome this challenge by considering several scenarios. Aside from game sales, revenue might come from advertising, merchandising related to game, and other target company’s projects.

The last component required for FCF estimation is Net Investments in Operating Capital. Net investments show increase in total net operating capital during the period. Operating capital means such assets as property, equipment, software that company needs for operations. Net investments can be calculated as the following formula:

\[
Net\ Investments = Capital\ Expenditures \minus Depreciation,
\]

(31)

where capital expenditures (Capex) is the money used to purchase or upgrade long-term assets, required for operations and depreciation which demonstrates declining value of assets. Thus it represents real value of assets. (InvestingAnswers, Inc., 2016)
Aside from inputs required for estimating FCF, discount rate needs to be chosen for estimation of present value of FCF. As it was mentioned earlier, present value will be estimated with multiple single-period discount rates, which means that the decision-maker can chose different rates for each month. This is important for analysis accuracy, because in real world market conditions are constantly changing and for example inflation might rise and decline during analyzing period several times. The period for which the DFC is calculated can be chosen by decision-maker as well. As a result of this step of the analysis, discounted cash-flow for each scenario is estimated and visualized with the pay-off distribution, described in chapter 2. The possibilistic mean is estimated for the pay-off distribution of stand-alone target company’s value.

Optionally valuation of target company’s corporate culture impact on revenue is offered to decision-maker. The video game industry experts did not have unique opinion about how corporate culture influences the value of the target company and the success of acquisition in general, that is why this part of analysis is optional for the decision-maker. The parameters described above are included in the analysis:

• Decision-making style;
• Leadership style;
• Ability to change;
• How people work together;
• Beliefs regarding personal “success” or teamwork. (Deloitte Development LLC, 2009)

For each parameter the decision-maker can chose the impact in percentage of total revenue. The impact could be positive or negative. Also the decision-maker is requested to valuate the relevance of each parameter for corporate culture. The relevance grades are from 0 to 10, thus, the irrelevant parameters can be removed from the analysis.

The total impact of the target’s corporate culture is measured as a weighted average of corporate culture parameters percentages, where relevance grades represent weights. Therefore, when in a particular case the decision-maker believes that target company’s corporate culture is highly affecting its revenue, this impact can be measured and included in the valuation. Otherwise, the corporate culture impact can be ignored.

6.3.2. Valuation of potential synergies

The next step of the analysis is to estimate cash-flows for the possible synergies obtained from acquisitions. Collan and Kinnunen (Collan & Kinnunen, 2009) suggested approach for
synergies valuation of seeing synergies as value created in addition to stand-alone value. The acquiring company can exercise the real options of synergies that it has and, thus, realize this added value.

Forecasting possible synergies is a complicated and obstructing task. Acquiring company is required to analyze potential magnitude and timing of the synergies and how they influence cash-flow in order to understand the value of the target company. (Deloitte Development LLC, 2013) However, often companies fail to accurately analyze synergies and realize them. There are several reasons why companies might not achieve synergies, in particular operating synergies, during M&A:

1. During planning stage. Companies concentrate more on getting short-term financial benefits of synergies rather than long-term. As a result, they eliminate many potential options and fail to reach desired level of synergy.
2. During preparation stage. Often during pre-acquisition due diligence, companies fail to do proper detailed analysis of all possible synergies. Consequently, operational synergies might be not thought through from the perspective of customers needs.
3. During implementation stage. Companies often underestimate the complexity of synergies strategy and mismanage it. (Deloitte Development LLC, 2013)

It is important not only to identify all synergy options that acquiring company has, but also to prioritize them. According to PricewaterhouseCoopers report “Capturing Synergies during Integration” (PricewaterhouseCoopers, 2009), prioritizing synergies is crucial for M&A success, because it is naturally not possible to realize every synergy. “There are simply too many competing priorities with too little time and resources available to execute”. The success can be achieved by focusing on options that bode to deliver the most shareholder value.

To analyze what synergies options acquiring company has, the company should look at these opportunities from three dimensions - three possible sources of synergy. These possible sources of synergy are shown in Figure 14. The sources are the following:

1. Revenue and market growth. The obvious way to increase revenue is to increase market share. Acquisition is a simple way to enter to new markets, new geographies, or to find new distribution channels. It all helps acquiring company to reach new customers. And one possible way to achieve this is cross-selling – it is a marketing approach of selling or suggesting related products to a customer. By acquiring new company, the acquirer is getting access to new customers, to whom it can sell some other products. Another example
of possible synergy is for example comes from developing new product by combining companies’ R&D efforts. (PricewaterhouseCoopers, 2009)

2. Cost Reduction and efficiency leverage. The synergies might come from permanent cutback in operating costs for instance from staff reduction, improved management of combined expenses, or increased productivity from joint operations for example economies of scale or use of more effective technology. Quite often opportunities for cost reduction can be found in business-supporting functional areas like procurement, payroll, finance, human resources and information technology. (PricewaterhouseCoopers, 2009)

3. Capital optimization. A possible resource for synergy can be found in company’s balance sheet. For instance, assets such as property, plant and equipment can be used more effectively and rationally or sold to someone else. Also this kind of synergy can be achieved through lower cost of capital or for example from better management of working capital, accounts receivable (collection periods, receivables turnover ratio, and optimizing debt-to-equity levels. (PricewaterhouseCoopers, 2009)

![Diagram of Sources of Synergy]

Figure 14. Sources of synergy.
The synergies are highly depending on successful post-acquisitions tactics. And should be explored as any other investment projects. Based on the possible reasons of acquisition mentioned by experts, we can derive several most plausible options for game development companies.

The experts’ answers described below can be seen from revenue increase perspective. First of all, by acquiring rights to popular franchise, the acquiring company gets the opportunities to promote any other products or game it has. It is valuable especially if the
acquirer wants to develop similar or a new one based on an acquired game. Using one game to promote another is a way of cross-promoting, a popular marketing solution in video game industry. **Cross-promotion** is a technique, which uses one product to promote the other. These products could be similar or related, but this is not obligatory. This marketing approach is particularly in use for mobile games. (Heinze, 2016)

As it was said earlier famous brand can attract potential buyers. Based on that brand, the acquiring company can increase revenue by selling game related products. **Merchandising** means products based on brand, which aiming to promote it and increase sales. Example of Rovio (Angry birds), which has about 45% revenue from selling brand-based production has been described earlier. (UKIE, 2014) Merchandising in game industry occupies a significant part of total sales. For example, in the UK game market, about 20% of total revenue in 2014 came from game brand based products. Toys, movies, soundtracks and books are the examples of such products.

Another reason of acquisition is to acquire more talented employees. Acquiring new talented employees will enhance professional level of team and moreover bring new ideas to the company. Sometimes acquisition is the only way to attract employees from competitors’ companies to your team. More experienced employees might share their valuable experience with others and teach them, which is alternative to any external training and studying. This type of synergy can be explained by **cross-fertilization**. According to Cambridge Dictionary (Cambridge University Press, 2016), cross-fertilization means mix of the ideas and customs of different places or group of people to produce a better result. Thus by acquiring talented team, the acquiring company can improve product and realize synergy.

Acquisition is an alternative to organic growth way to expand to new markets. By expanding the network of locations, audience, platforms and the business, the acquiring company gets access to new customers. This extension to new customers is called **cross-selling**.

Reducing costs is one possible way to achieve synergy. Production and development, marketing, distribution, manufacturing, research and development mostly form the game budget. Thus in these areas the acquiring company should seek for potential cost reductions. As it was said earlier **production and development** of a new game is very expensive and time consuming. By joining resources acquiring company might reduce costs related to game production process. It might have happened due to many reasons, for
example by usage of better technologies or more sophisticated tools. It was noticed by experts that one of the acquisition motives is to improve technical base.

Promoting a game requires considerable investments. Nowadays success of a game is highly depending on a marketing campaign. After acquisition, companies might combine marketing efforts, and thus cut some promotion related costs. Described above marketing techniques such as cross-promotion will allow to spend less on a marketing campaigns.

**Distribution** of a game is another important part of game development company costs. If acquiring or acquired company has already developed distribution channels, the synergy can be realized by reducing distribution-related costs. Although manufacturing costs differ depending on game type, they still need to be considered in the target value analysis. It is a significant part of budget for game consoles or for example, for new area of gaming – virtual reality. Synergy can be achieved for instance due to economies of scale.

Synergy can be achieved by reducing costs on research and development after acquisition. With no doubt, many game development companies do not perform any research, but still the industry’s technologies are constantly evolving and new types of games and games equipment appear on the market. For example, Oculus VR developed new equipment for virtual reality. Thus R&D expenses should be considered for potential synergies.

The third type of synergy sources is capital optimization. As it was said earlier, it might include for instance more rational use of assets such as selling non-core assets or lower costs of capital. Although this type of synergy might have lower impact on total synergies value, it is important to include it in the analysis. The described above sources of synergies are just the most likely examples of what acquiring company can look at during pre-acquisition phase. However, synergies should be thoroughly analyses in each particular case.

In this chapter game development company valuable assets as algorithm inputs and their measurement were described. These assets could be considered for the valuation at different stages of the target company valuation such as target's economic capital (assets value), strategic capital and acquirer strategic and economic capital (synergies). The uncertainty related to the input values is treated by providing not a single value but a set of three values - extremely pessimistic, extremely optimistic and most likely which limit range
of possible values. Another way to make valuation more accurate is the use of multiple one period discount rates for estimation of target cash-flows present value.

This algorithm should be performed for each selected target company separately. After all targets are valued, the acquiring company might choose the final company for the acquisition, which suits the most acquisition goal and priorities.
7. IMPLEMENTATION AND NUMERICAL ILLUSTRATION

7.1. Implementation of algorithm

The implementation of the valuation algorithm (Appendix 4) is done with HTML and JavaScript. HTML or Hyper Text Mark-up Language was created in 1991 by Tim Berners-Lee. The idea was to find a way of sharing information by using hyperlinks – HTML-coded links that connect one resource to another. (Boswell, 2016) Main advantage of HTML is convenient table layout, similar to MS Excel, but compared to the latter it provides flexibility for dynamic elements with the help of JavaScript that is more suitable for stochastic character of video game industry. Also it gives more flexibility to the decision-maker to adjust inputs to the real life cases. JavaScript is a programming language used to make web pages interactive in other words it is designed for performing dynamic tasks. (Chapman, 2016)

One of the major advantages of the languages chosen for this implementation is that they are cross-platform and the written application could be opened in any browser with no need in the internet access. JavaScript also does not require any compilation, because it is a script language, which also benefits algorithm implementation usability. Also free software is in use for work with this implementation (browsers). The implementation is open source software, therefore, the valuation tool could be adjusted for specific cases and needs. Moreover, it presents results in a form of easily-readable tables and graphs. Thus, proposed implementation also has user-friendly interface. (Appendix 3)

7.2. Numerical illustration

In this subsection a fictional numerical example is presented to demonstrate capacities of the valuation tool. Assume the acquiring company is aiming to value a medium-sized game development company. The acquiring company is planning to develop a sequel based on the most popular mobile game of this target, but at the same time is going to support the old version of the game, because it will help to promote the sequel. The period of calculation is 24 months of which 10 months will take to develop a sequel. The fist stage of the analysis includes valuation of target as stand-alone, which means valuation of target’s assets and future growth. This section’s inputs depict current state of the target company. The examples of inputs interface could be found in the Appendix 3.

In the extremely pessimistic scenario, the acquiring company’s manager performing the valuation believes that the target company has assets which worth $2000. The economic conditions will be not favoring during the investment period and the discount rate will be 13% for the first 12 months and 15% for the next 12 months due to a high inflation. Although
the main game of the acquiring company is quite popular and has many downloads, in worst case the number of monthly active users is relatively low (5000 users) and the average revenue per user is just $1.5. The number of users will decline during 24 months, and for the last 12 months will be equal to 2500. This could be explained, for example, by tedious gameplay. The target company does not have any other source of revenue in this case. The net investments in the operating capital of the target is $200, because some of the important equipment owned by the target need to be repaired. The operating costs are $50000 for salaries, $500 for development tools, $100 for game engine, $500 for server hosting and $400 for equipment rent, and $500 for marketing. Finally, digital distribution costs are $1500 and other costs are $1800.

\[ \text{Figure 15. The cumulative discounted free cash-flow for target as stand-alone.} \]

\[ \text{Figure 16. The pay of distribution for target as stand-alone.} \]

In the most likely scenario, the target company has assets which cost $15000. The economic condition will be moderate during the selected period, and the discount rate will
be 7% for first 10 months, 6% for the next 7 months and 5% for the rest of the period. The number of active monthly users is 20000 and the average revenue per user is $2.5. The number of active users will increase and reach 30000 for the second year. Additionally, the target company receives $2000 each month from advertising and other activities. The net investment in net investing capital is $100. The operating costs includes $40000 for salaries, $300 for development tools $80 for game engine, $400 for server hosting, $200 for equipment rent, $400 for advertising, $3000 for digital distribution and $1500 for administrative and other costs.

In the extremely optimistic scenario, the target company has assets which worth $30000. The economic condition is favorable and the discount rate is 4.5% for the whole period. The number of monthly active users is 40000 and the average revenue per user is $3.5. The number of active users will reach 55000 for the last 14 months. Additional revenue in the extremely optimistic scenario is $5000. There will be no investments in the operating capital of the target. Monthly operating costs are $25000 for salaries, $100 for development tools $80 for game engine, $300 for server hosting, $300 for advertising and $5000 for digital distribution and $1300 for administrative and other costs.

![Figure 17. The cumulative discounted free cash-flow of potential synergies.](image)

Corporate culture influence is an optional section, however, in this case the manager believes that the target company’s corporate culture influences the revenue. In the pessimistic scenario, the influence is negative and both target’s decision-making style and leadership style decrease revenue on 3% with weights of 4 and 5 accordingly. In the most likely scenario the way team work together increases the revenue by 5% with weight of 6. In optimistic scenario both leadership style and ability of employees to work together increase the revenue on 6% with the weights of 7 and 5 respectively.
Figure 18. The pay-off distribution of potential synergies.

The cumulative discounted free cash-flow and the pay of distribution for target as stand-alone presented in Figure 15 and Figure 16 respectively. In the cumulative discounted free cash-flow graph the green line demonstrates the extremely optimistic scenario, the blue line – the most likely scenario and the red line – extremely pessimistic scenario. In the Figure 16 the blue line is the possibilistic mean of the pay-off distribution. It can be seen from this figure, that the possibilistic mean has higher value than the most likely scenario.

Figure 19. The cumulative discounted free cash-flow of target company with potential synergies.

The next step of analysis is a valuation of potential synergies, which might come from increased revenue and market share, cost reduction and capital optimization. Since the acquiring company is going to develop a new game based on the target’s product, the synergy is expected to come from cross-promotion. In the worst case scenario, no synergy is expected, in optimistic scenario the synergy is $100800, but most likely it $70000. The revenue increase is calculated for the period from 11th till 24th month. The promotion
campaign worth $3000 in all scenarios and paid during the first 11 months after the acquisition. Also the target company team will share experience and ideas with the acquiring company. Thus, due to cross-fertilization the acquiring company will increase revenue by 5% starting in 13\textsuperscript{th} month after the acquisition in the pessimistic scenario, 10% in 7\textsuperscript{th} month in the most likely scenario and 15% in 4\textsuperscript{th} month in the optimistic scenario. Another source of revenue increase is cross-selling potential through the target company facilities. In the pessimistic case there is no revenue increase, but $300 costs per months for the period from 1\textsuperscript{st} till 4\textsuperscript{th} month, $4000 revenue increase after 4\textsuperscript{th} month after the acquisition in the most likely case with $300 costs from 1\textsuperscript{st} till 6\textsuperscript{th} month and $7000 increase after 3\textsuperscript{rd} month in the optimistic case with $200 costs from 1\textsuperscript{st} till 5\textsuperscript{th} month.

The sources of cost reduction in the pessimistic scenario are marketing and administrative costs with 10% cut for the whole period of time without any additional costs and production and development costs with 40% cut for the whole period, because the game is going to be supported without any improvements. In the most likely scenario the acquiring company cuts marketing, distribution and manufacturing costs by 15% and production and development costs by 50% for the whole period without any additional investments. Also the acquiring company reduces administrative costs by 25% starting from the 3\textsuperscript{rd} month with $100 costs for the period of the first 6 months. In the extreme optimistic scenario, the acquiring company reduces production and administrative costs by 50% and marketing and distribution costs by 20% without any investments.

Balance-sheet synergy allows to achieve in the most likely scenario $150 gain starting from the 3\textsuperscript{rd} month and in the optimistic case $300 benefit starting from the beginning of the acquisition. The discount rate for synergies for the pessimistic scenario is 13%, for the most

![Figure 20. The pay-off distribution of the target company with potential synergies.](image-url)
likely scenario is 6% and for the optimistic scenario is 5%. Figure 17 and 18 represent the cumulative discounted cash-flow and the pay-off distribution of potential synergies accordingly.

Figure 19 and 20 demonstrates the cumulative discounted free cash-flow and the pay-off distribution for the target company value with potential synergies respectively. It means that these figures show the total sum of the stand-alone and the synergies values. The possibilistic mean represents the most plausible value of the target company based on the acquiring company manager’s opinion and as it can be seen in the Figure 21 it has higher value that the most likely scenario. The obtained analysis and valuation can be used to aid the decision-maker in making the acquisition decision and to evaluate and set the maximum value that can be paid for the target company.
8. DISCUSSION AND CONCLUSION

Recently, the video game industry reached its record of the acquisition deal value and the overall amount of M&A deals increased significantly. However, the acquisitions in the video game industry have not been studied enough by the scientific community. This research is aiming to fill this gap by studying video game industry features and developing target company valuation tool which will facilitate the decision-making process on the pre-acquisition stage.

By conducting interviews with video game industry experts, the answers to the research questions were obtained. The first research question requested information about target company’s important assets that might attract acquiring company. The respondents ranked the assets based on the degree of their importance to the acquiring company (Table 7). The most essential assets of the game development company are the rights to the franchise, meaning rights to the final product of the company, and employees – a team that efficiently works together. In addition to these two assets, experts named also marketing, which includes marketing team and recognizable brand, productive development process and effective tools, and corporate culture. The answers to this research question allow to include in the valuation algorithm the components which are distinctive for the game development industry.

The second research question set out to find possible motives of acquisition specific for the video game industry. To detect these motives both previous scientific studies and industry experts’ opinions were used. The former is presented by the Trautwein study which classifies possible acquisition motives into seven theories, which were discussed in the Theoretical background section of this research. The Trautwein stated that the most plausible reasons of acquisition without industries differentiation according to empirical evidence are valuation, process and empire-building theories. The video game experts listed nine different reasons, which could be grouped under Trautwein motives classification into efficiency and monopoly theories. The efficiency theory contains such reasons as getting access to different assets such as rights to popular franchise, talented employees, technical base, tools, famous brand and others. By accessing these assets, acquiring company could both significantly improve its performance and thus increase revenue and reduced cost required for game production. The monopoly theory assumes that M&A is performed to increase market power and explains the motive to diversify business with new types of game, reduce competition and expand to new markets and locations. In contrast to Trautwein study, which assumes valuation, process and empire-building theories to have
the higher degree of plausibility, the experts believe that efficiency and monopoly theory are more plausible for the video game industry.

The third research question inquire about the existence of what kind of real options might appear in the case of acquisitions in the video game industry. Including these real options to the algorithm makes it tailored to the video game industry. In this research “high level” real options were defined based on the acquisition motives defined in the previous research questions. The first option is to grow the company (increase the market share) through the acquisition. This option includes such “low level” options as geographical expansion, reducing competition and diversification of game catalogue. The second “high level” option is option to create synergy, which could be achieved through increasing revenue by accessing rights to famous game, recognizable brand, talented team, and new audience and locations and through reducing costs which could be reached by improving technical base, development process and reducing time to market.

Aside from the answers to the research questions such topics as factors that make game development team, games or acquisition successful were discussed with the experts. Ability to adjust to changes, the best possible quality, well-thought out business model and management skills were named by the respondents as qualities that bring success to game development company (Figure 9). These are the qualities that the acquiring company should pay attention to while choosing between different target companies. For a game the essential success factor is its quality. According to the experts, the acquisition will be successful if it is well-planned, everything concerning acquisition is agreed in advance, the target company is known in details, and the post-acquisition steps are thought through (Figure 11).

In addition, the influence of target company’s corporate culture on the M&A was examined. The experts’ opinions were controversial. This inconsistency is supported by overview of acquisition studies performed by Cartwright and Schoenberg. According to this overview, researches dedicated to relations of culture and performance in a context of M&A give rather mixed and contradictory results. (Cartwright & Schoenberg, 2006) In our research some of the respondents believe that cultural differences don’t matter, or at least till the acquisition is done, because this is not an issue for video game industry. Some of them think that it is crucial to be aware of possible cultural difficulties, because the cultural differences might affect the results and success of an acquisition. However, it is known that cultural distance between acquiring and target companies might affect their market value negatively.
(Alexandridis, et al., 2016) Therefore, cultural issues are included in the valuation algorithm as an optional section.

As a basis for the valuation tool an algorithm suggested by Collan and Kinnunen in “A Procedure for the Rapid Pre-Acquisition Screening of Target Companies Using the Pay-off Method for Real Option Valuation” was chosen. This algorithm allows to quickly value target company and due to applying of the pay-off valuation method gives flexibility to manager and treat uncertainty related to the valuation process. In this research as well as in the algorithm of Collan and Kinnunen, the target valuation process consists of valuation target as stand-alone company and valuation of potential synergies. To depict the decision-maker uncertainty about inputs, three scenarios are created during the valuation – the extremely pessimistic, the most likely and the extremely optimistic. The present value of cumulative discounted cash-slow is estimated for both target stand-alone and synergies valuation for each scenario and based on these values the pay-off distributions are built. Next, the possibilistic mean is calculated for each distribution. The possibilistic mean represents the value of the real option, therefore, the value of option to grow the company through acquisition and option to create a synergy will be obtained. The final step of the analysis includes building distribution for sum of the target as stand alone value and possible synergies value and finding the possibilistic mean for this distribution.

In this work for the target as stand alone valuation the impact of target company’s corporate culture is suggested to valuate as additional step. This impact is measured as a weighted average of corporate culture parameters percentages, where relevance grades represent weights. The corporate culture parameters were defined by Deloitte Development LLC and includes decision-making style, leadership style, ability to change, the way people work together, and company’s beliefs regarding personal “success” or teamwork. (Deloitte Development LLC, 2009) This step is optional to the decision-maker.

The algorithm is adjusted to the game development company features. The return from the game could be calculated as the number of active users multiplied by the average revenue per user, because the number of active users is a key indicator for the video game company success. Alternatively, the decision maker can input the total revenue value from the game sales. Also the operating costs valuation inputs includes he most plausible cost for the video game company. The same adjustment is made for the synergies valuation, where suggested possible synergies reflect the acquisition motives suggested by the experts.
The tool is designed to follow mobility of the constantly changing video game industry. Several important inputs, such as discount rate and number of monthly active users, are designed as dynamic tables for this purpose. It means that, for example, the discount rate which is used for estimation of present value of cash-flow can be chosen separately for each month of the valuation period. Thus, the multiple one period discount rates allow to adjust the valuation to the unstable market conditions. Different rates could be chosen for target stand-alone and synergies valuation, because different risk level could be involved.

8.1. Limitations and suggestions for further research
One of the limitations arises from experts’ interviews. Experts background and professional area affect their knowledge about the video game industry and therefore their answers. With different selection of the experts, different results might be received in the research, thus, affect the valuation tool created based on the interview results. Further extension of this research could be achieved through changing the way primary data is collected. One possible option is to perform interviews where experts’ background is specified by, for instance, previous experiences, professional area, geographical locations. Also the results received from interviews could be affected by the amount of the experts, therefore, the number of respondents could be increased in future researches.

Acquiring company might have multiple motives for acquisition and it is a very complex task to predict all of them. This research concentrates only on the most plausible reasons, such as desire to increase market share and received the synergy. Additionally, in this research we assume that acquisition is a rational decision and should benefit to the acquiring company and its shareholders’ interests. Therefore, other reasons are left out of the scope of the research. Further studies might observe other reasons and include them in the valuation algorithm.

In this research the “high level” real options are used for the development of the valuation tool, because it allows to superficially observe the most plausible cases of acquisition and therefore develop a tool that suits the needs of the majority of potential users. Therefore, further research could focus on more specific real options or include “low level” options into valuation algorithm. Thus, a more detailed valuation tool could be developed based on the results of the research.
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APPENDIX 1

Interview questions

1. What are the most valuable (important) assets of a game development company? (if possible, put them in an order from the most important to less important)

2. What makes game development company successful? What makes its product successful?

3. What might be possible reasons for a company in this industry to make an acquisition?

4. What factors are important for a successful acquisition? What makes this acquisition successful?

5. Is a cultural difference between acquiring and acquired company influence the success of the acquisition? How important is the "identity" of the acquiring company to the company being acquired?
APPENDIX 2

The development of game industry

1948 first known game - chess simulation by A.Turing and D.Champernowne
1950 “Bernie the Brane” presented by J.Kates and R.Majestic
1962 “Spacewar!” - first influential game
1967 first game console
1970 arcade game popularity rise with “Computer Space”
1971 Japan game market produced very popular arcade game “Space Invaders”
1972 Magnavox Odyssey game for TV set
1972-1982 the second generation of game consoles
1978-1982 “the Golden Age” of arcade games
1979 first handheld was introduced to public
1980 very popular arcade game “Pacman” was released in Japan
1981 first network game “Snipes”
1980s development of first 3D games with simple graphics
1980s Technical progress (Unix, C, Plato System etc.) important for PC games
1982-1989 the third generation of consoles with 8-bit display
1983 Video game industry crisis
1984 development of first MMORPGs
1985 Creation of World Wide Web which facilitate development of online games
1987-1989 the fourth generation of consoles with 16-bit display, GameBoy with “Tetris”
1989-1996 consoles with 64-bit display with 3D graphics, the fifth generation of console
1996 development of 3D games with advanced graphics (Voodoo chipset)
1996-1998 the sixth generation of consoles with access to the Internet
1997 first popular mobile game “Snake” by Nokia
1998-2005 the seventh generation of consoles with high-definition graphics via HDMI
2003 Nokia N-Gage (mobile phone and handheld in one)
2005 Nokia N-series with game market
2005 – now the eighth generation of consoles with Wi-Fi, 3G, x86 architecture
2007 creation of game and application markets for mobile (Appstore, Google play)
2008 New wave of casual games popularity (through social networks, e.g. Facebook)
APPENDIX 3

Valuation tool inputs. Target as stand-alone valuation.

<table>
<thead>
<tr>
<th></th>
<th>Acquisition scenarios</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Extremely pessimistic</td>
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<td>Analysis period (months)</td>
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<tr>
<td>Total sum of company’s assets ($)</td>
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<td>Annual discount rate (%)</td>
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<td>Average revenue per user ($)</td>
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Valuation tool inputs. Valuation of potential synergies from cost reduction and balance-sheet synergies.

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Balance-sheet synergies

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</table>
APPENDIX 4

The valuation tool code

```html
<html>
<head>
  <style type="css/text">
  
  </style>
  <script>
    var scenarios = ["Pes", "", "Opt"];

    function setVisibility(divName, isVisible)
    {
      document.getElementById(divName).style.display = (isVisible ? "" : "none");
    }

    function createRevenueSynergy(displayName, name, synType)
    {
      var bodyHTML = '<tr>
        <td rowspan="' + (synType == "" ? "6" : "7") + '">'+displayName+'</td>
        <td rowspan="' + (synType == "" ? "3" : "4") + '">revenue</td>
      ';           
      if(synType != "")
      {
        bodyHTML += '<td>as % of</td>+' + synType + '</td>
        for(var i = 0; i < 3; ++i)
        {
          bodyHTML += '<td><input type="number" min="0.0" max="100.0" value="0.0" step="0.1" id="elemSyn' + name + 'ProfPerc' + scenarios[i] + '" onchange="updateSynergy(this)" style="width: 60;">"</td>;
        }

        bodyHTML += '</tr><tr>
          <td>as value</td>
          for(var i = 0; i < 3; ++i)
          {
            bodyHTML += '<td><input type="number" min="0" max="1000000" value="0" id="elemSyn' + name + 'ProfVal' + scenarios[i] + '" onchange="updateSynergy(this)" style="width: 100;">"</td>;
          }
          bodyHTML += '</tr><tr><td>start month</td>
          for(var i = 0; i < 3; ++i)
          {
            bodyHTML += '<td><input type="number" min="1" max="120" value="1" step="1" id="elemSyn' + name + 'ProfStartMonth' + scenarios[i] + '" onchange="updateSynergy(this)" style="width: 60;">"</td>;
          }
          bodyHTML += '</tr><tr><td>end month</td>
          for(var i = 0; i < 3; ++i)
          {
            bodyHTML += '<td><input type="number" min="1" max="120" value="1" step="1" id="elemSyn' + name + 'ProfEndMonth' + scenarios[i] + '" onchange="updateSynergy(this)" style="width: 60;">"</td>;
          }
          bodyHTML += '</tr>
      }

      bodyHTML += '</tr>
    }

    function updateSynergy(element)
    {
      var displayBlock = document.getElementById(' + name + 'DisplayBlock');
      displayBlock.innerHTML = element.value;
    }
  </script>
</head>
<body>
  <table id="elemSynTable">
    <tr>
      <td>
        <input type="text" id="elemSynName" value="" onchange="createRevenueSynergy(' + name + ', this)" style="width: 300;">"</td>
      </tr>
      <tr>
        <td>
          <input type="text" id="elemSynDesc" value="" onchange="createRevenueSynergy(' + name + ', this)" style="width: 300;">"</td>
      </tr>
      <tr>
        <td>
          <input type="text" id="elemSynType" value="" onchange="createRevenueSynergy(' + name + ', this)" style="width: 300;">"</td>
      </tr>
      <tr>
        <td>
          <input type="text" id="elemSynDisplayBlock" value="" onchange="createRevenueSynergy(' + name + ', this)" style="width: 300;">"</td>
      </tr>
      <tr>
        <td>
          <input type="text" id="elemSynDisplayBlockTitle" value="" onchange="createRevenueSynergy(' + name + ', this)" style="width: 300;">"</td>
      </tr>
      <tr>
        <td>
          <input type="text" id="elemSynDisplayBlockSubtitle" value="" onchange="createRevenueSynergy(' + name + ', this)" style="width: 300;">"</td>
      </tr>
    </table>
  
```
```
+name+"ProfEndMonth"+scenarios[i]+" onchange="updateSynergy(this)" style="width: 60;">";}
}
bodyHTML += '<tr><td rowspan="3">costs</td><td>value</td>
for(var i = 0; i < 3; ++i)
{
    bodyHTML += '<td><input type="number" min="0" max="1000000" value="0" id="elemSyn'
+name+"CostsVal"+scenarios[i]+" onchange="updateSynergy(this)" style="width: 60;">";
}
bodyHTML += '</tr><tr><td>start month</td>
for(var i = 0; i < 3; ++i)
{
    bodyHTML += '<td><input type="number" min="1" max="120" value="1" step="1" id="elemSyn'
+name+"CostsStartMonth"+scenarios[i]+" onchange="updateSynergy(this)" style="width: 60;">";
}
bodyHTML += '</tr><tr><td>end month</td>
for(var i = 0; i < 3; ++i)
{
    bodyHTML += '<td><input type="number" min="1" max="120" value="1" step="1" id="elemSyn'
+name+"CostsEndMonth"+scenarios[i]+" onchange="updateSynergy(this)" style="width: 60;">";
}
bodyHTML += '</tr>

return bodyHTML;
}

function getEl(name)
{
    return document.getElementById(name);
}

function loadExample()
{
    getEl("monthsPeriod").value = 24;
    var standalNames = [
        "elemAssets",
        "discRatePerc",
        "activeUsers",
        "avrgRevUser",
        "salesRevenue",
        "otherRevenue",
        "netInvest",
        "elemCostsSalaries",
        "elemCostsMusic",
        "elemCostsDevTools",
        "elemCostsEngines",
        "elemCostsHosting",
        "elemCostsRent",
        "elemCostsRND",
        "elemCostsAds",
        "elemCostsLaunch",
        "elemCostsConference",
        "elemCostsManufacture",
    ];
"elemCostsRetail",
"elemCostsDigit",
"elemCostsAdmin",
"elemCostsOther",
"discRatePercSyn"
];

var standalVals = [
[2000, 15000, 30000],
[13.0, 7.0, 4.5],
[5000,20000,40000],
[1.5,2.5,3.5],
["",",","],
[0,2000,5000],
[200,100,0],
[50000,40000,25000], // salaries
[0,0,0], // voice
[500,300,100], // development tools
[100,80,80], // game engines
[500,400,300], //servers
[400,200,0], // equipment rent
[0,0,0],
[500,400,300], // advertising
[0,0,0],
[0,0,0], // manufacturing
[0,0,0],
[1500,3000,5000], // digital distribution
[0,0,0],
[1800,1500,1300],
[8.0, 6.5, 5.0]
];

for(var i = 0; i < standalNames.length; ++i)
{
    for(var k = 0; k < 3; ++k)
    {
        getEl(standalNames[i]+scenarios[k]).value = standalVals[i][k];
    }
}

var ccNames = [
"corpCultureDecision",
"corpCultureLeader",
"corpCultureChange",
"corpCultureTogether",
"corpCultureBeliefs"
];

var ccVals = [


[[[-3.0,4],[0.0,0],[0.0,0]], // decision
 [[-3.0,5],[0.0,0],[6.0,7]], //leadership
 [[0.0,0],[0.0,0],[0.0,0]], // ability to change
 [[0.0,0],[5.0,6],[6.0,5]], // work together
 [[0.0,0],[0.0,0],[0.0,0]] // success
];

for(var i = 0; i < ccNames.length; ++i)
{
    for(var k = 0; k < 3; ++k)
```javascript
function loadTablesAndSyn()
{
    var table1Id = "testTable";
    var table1Vals = [
        [[13, 7, 4.5], [5000, 20000, 400000]],
        [[13, 7, 4.5], [5000, 20000, 400000]],
        [[13, 7, 4.5], [5000, 20000, 400000]],
        [[13, 7, 4.5], [5000, 20000, 400000]],
        [[13, 7, 4.5], [5000, 20000, 400000]],
    ];
    for(var i = 0; i < table1Vals.length; ++i)
    {
        for(var k = 0; k < 3; ++k)
        {
            var el = getEl(table1Id+"_locDiscRate"+scenarios[k]+i);
            if (el != null)
            {
                el.value = table1Vals[i][0][k];
            }
            el = getEl(table1Id+"_locUsersNum"+scenarios[k]+i);
            if (el != null)
            {
                el.value = table1Vals[i][1][k];
            }
        }
    }
    var synVals = [
        {getEl(ccNames[i]+"Perc"+scenarios[k]).value = ccVals[i][k][0];
        getEl(ccNames[i]+"W8"+scenarios[k]).value = ccVals[i][k][1];
    }
}
```
var synParamsNames = [
    'ProfPerc',
    'ProfVal',
    'ProfStartMonth',
    'ProfEndMonth',
    'CostsVal',
    'CostsStartMonth',
    'CostsEndMonth'
];

var synTypesNames = [
    "CrossPromo",  
    "Merch",  
    "CrossFert",     
    "CrossSell",     
    "Other",     
    "ProdAndDev",  
    "RAndD",  
    "Market",  
    "DistrAndMan",  
    "AdminOthers", 
    "Finance"
];

for(var i = 0; i < synVals.length; ++i)
{
    for(var k = 0; k < 3; ++k)
    {
        for(var j = 0; j < synParamsNames.length; ++j)
        {
            var nm = 'elemSyn'+synTypesNames[i]+synParamsNames[j]+scenarios[k];
            var el = getEl(nm);

            if (el != null)
            {
                el.value = synVals[i][k][j];
            }
        }
    }
}

function onInit()
{  
    loadExample();
}
updateCorpCulture();
updateTotalCosts();
updateIndirectSalesRevenue(0);
updateIndirectSalesRevenue(1);
updateIndirectSalesRevenue(2);

var synergyTableBody = document.getElementById("revenueSynergiesTableBody");
synergyTableBody.innerHTML += createRevenueSynergy("Cross-promotion", "CrossPromo", "revenue");
synergyTableBody.innerHTML += createRevenueSynergy("Merchandizing", "Merch", "revenue");
synergyTableBody.innerHTML += createRevenueSynergy("Cross-fertilization", "CrossFert", "revenue");
synergyTableBody.innerHTML += createRevenueSynergy("Cross-selling", "CrossSell", "revenue");
synergyTableBody.innerHTML += createRevenueSynergy("Other", "Other", "revenue");

var costsSynergyTableBody = document.getElementById("costsSynergiesTableBody");
costsSynergyTableBody.innerHTML += createRevenueSynergy("Production and development", "ProdAndDev", "costs");
costsSynergyTableBody.innerHTML += createRevenueSynergy("R&D", "RAndD", "costs");
costsSynergyTableBody.innerHTML += createRevenueSynergy("Marketing", "Market", "costs");
costsSynergyTableBody.innerHTML += createRevenueSynergy("Distribution and manufacturing", "DistrAndMan", "costs");
costsSynergyTableBody.innerHTML += createRevenueSynergy("Administrative and others", "AdminOthers", "costs");

var financeSynergyTableBody = document.getElementById("financeSynergiesTableBody");
financeSynergyTableBody.innerHTML += createRevenueSynergy("Balance-sheet synergy", "Finance", ""); 
loadTablesAndSyn();
updateSynergy(null);

function getVirtX(x, minX, maxX, w) 
{ 
var wVirt = maxX-minX;
 return (x-minX)*w/wVirt;
}

function drawRealOption(minTrX, maxTrX, midTrX, graphCanvas) 
{ 
var cv = graphCanvas;
var w = cv.width;
var h = cv.height;
var border = 30;
var wVirt = w-2*border;
var top = 2*border;
var bot = h-border;
var oxDigY = h-2;
var oxDigY2 = h-17;

var minX = Math.min(0, minTrX);
var maxX = Math.max(0, maxTrX);
```javascript
var ctx = cv.getContext("2d");
ctx.clearRect(0, 0, w, h);
// OX axis
ctx.beginPath();
ctx.lineWidth="2";
ctx.strokeStyle="black";
ctx.moveTo(border, bot);
ctx.lineTo(w-border, bot);
ctx.stroke();
// OY axis
var oyX = border+getVirtX(0, minX, maxX, wVirt);
ctx.beginPath();
ctx.moveTo(oyX, bot);
ctx.lineTo(oyX, top-border);
ctx.lineTo(oyX-border/2, top);
ctx.lineTo(oyX+border/2, top);
ctx.stroke();
// 0 - axes interception
ctx.font="12px Arial";
ctx.textAlign="center";
ctx.fillText("0", oyX, oxDigY2);
ctx.fillText("1", oyX-5, top+5);
// Triangle
ctx.beginPath();
ctx.lineWidth="2";
ctx.strokeStyle="red";
var cMinX = border+getVirtX(minTrX, minX, maxX, wVirt);
ctx.moveTo(cMinX, bot);
ctx.fillText(minTrX.toFixed(0), cMinX, oxDigY);
var cMaxX = border+getVirtX(maxTrX, minX, maxX, wVirt);
ctx.fillText(maxTrX.toFixed(0), cMaxX, oxDigY);
ctx.lineTo(cMaxX, bot);
var cMidX = border+getVirtX(midTrX, minX, maxX, wVirt);
ctx.lineTo(cMidX, top);
ctx.lineTo(cMidX, bot);
ctx.stroke();

// Dashed line of the top vertex
if(ctx.setLineDash)
{
    //ctx.save();
    ctx.setLineDash([10]);
    ctx.beginPath();
    ctx.moveTo(cMidX, bot);
    ctx.lineTo(cMidX, top);
    ctx.lineTo(oyX, top);
    ctx.stroke();
    ctx.fillText(midTrX.toFixed(0), cMidX, oxDigY);
    ctx.setLineDash([]);
    //ctx.restore();
}

// The positive area
var fullArea = (maxTrX-minTrX)/2;
var positiveArea = 0;
var EApos = 0;
```
var beta = maxTrX - midTrX;
var alpha = midTrX - minTrX;

if(maxTrX > 0)
{
    ctx.beginPath();
    ctx.lineWidth="1";
    ctx.strokeStyle="rgba(255, 0, 0, 0.5)";
    var oldFillStyle = ctx.fillStyle;
    ctx.fillStyle="rgba(255, 0, 0, 0.5)";
    ctx.moveTo(cMaxX, bot);
    if(midTrX > 0)
    {
        positiveArea = (maxTrX - midTrX)/2;
        ctx.lineTo(cMidX, top);
        if(minTrX > 0)
        {
            positiveArea += (midTrX - minTrX)/2;
            EApos = midTrX + (beta-alpha)/6;
            ctx.lineTo(cMinX, bot);
        }
    }
    else
    {
        positiveArea += (midTrX - minTrX)/2 - (minTrX*minTrX)/(midTrX - minTrX)/2;
        EApos = midTrX + (beta-alpha)/6 + Math.pow(alpha-beta, 3)/6/Math.pow(alpha, 2);
        var minIntY = top;
        if(cMidX != cMinX)
            minIntY = top+(cMidX-oyX)*(bot-top)/(cMidX-cMinX);
        ctx.lineTo(oyX, minIntY);
        ctx.lineTo(oyX, bot);
    }
}
else
{
    var midIntY = top;
    if(cMaxX != cMidX)
        midIntY = top+(oyX-cMidX)*(bot-top)/(cMaxX-cMidX);
    ctx.lineTo(oyX, midIntY);
    ctx.lineTo(oyX, bot);
    EApos = Math.pow(midTrX+beta, 3)/6/Math.pow(beta, 2);
    positiveArea = (maxTrX*maxTrX)/(maxTrX - midTrX)/2;
    ctx.lineTo(cMaxX, bot);
    ctx.fill();
    ctx.stroke();
    ctx.fillStyle = oldFillStyle;
}

var ROV = EApos*positiveArea / fullArea;
// ROV
ctx.beginPath();
ctx.lineWidth="2";
ctx.strokeStyle="blue";
var cROVX = border+getVirtX(ROV, minX, maxX, wVirt);
ctx.moveTo(cROVX, top);
ctx.lineTo(cROVX, bot);
ctx.fillText(ROV.toFixed(0), cROVX, oxDigY2);
ctx.stroke();

return ROV;

///////////////////////////////////////////////////////////////////////////////////////////////////////
// Table discount rate and Scenarios

function DiscountedCashFlowTable(id, parentElem, locCallbackName, initVals, monthsPeriod, discRatesPerc, numberOfUsers, averageRevenuePerUser) {
    this.tableId = id;
    this.parentElem = parentElem;
    this.initVals = initVals;

    this.numUsers = numberOfUsers;
    this.avrgRevUser = averageRevenuePerUser;
    if (!Array.isArray(initVals[0])) {
        this.initVals = [[], [], []];
        for (var j = 0; j < 3; ++j) {
            for (var i = 0; i < monthsPeriod; ++i) {
                this.initVals[j].push(initVals[j]);
            }
        }
    }
    this.monthsPeriod = monthsPeriod;
    this.discRatesPerc = discRatesPerc;
    this.locCallbackName = locCallbackName;
    this.yVals = [[], [], []];

    this.scenTexts = ["Extremely pessimistic", "Most likely", "Extremely optimistic"];

    this.setDiscountedValueRow = function (idx) {
        var totalDisc = 1.0;
        var sumVal = 0;
        tableHTML = "</tr>";
        tableHTML += "<td>Discounted value</td>";
        for (var i = 0; i < this.monthsPeriod; ++i) {
            var locDiscRate = this.discRatesPerc[idx];
            var locDiscRateElem = document.getElementById(this.tableId + "_locDiscRate" + scenarios[idx] + i);
            if (!isNaN(this.numUsers[idx])) {
                var locUserNum = this.numUsers[idx];
                var locUserNumElem = document.getElementById(this.tableId + "_locUsersNum" + scenarios[idx] + i);
            }
            if (locDiscRateElem !== null) {
                locDiscRate = locDiscRateElem.value;
            }
            if (!isNaN(this.numUsers[idx])) {

```
if(locUserNumElem != null)
{
    locUserNum = locUserNumElem.value;
}
}

totalDisc = totalDisc / Math.pow(1.0+locDiscRate/100.0, 1.0/12.0);
var currVal = 0;
if(!isNaN(this.numUsers[idx]))
currVal = (this.initVals[idx][i] + (locUserNum -
this.numUsers[idx]) * this.avgRevUser[idx]) * totalDisc;
else
currVal = this.initVals[idx][i] * totalDisc;
sumVal += currVal;
this.yVals[idx].push(sumVal);

var locDiscValElem = document.getElementById(
this.tableId+"_discVal"+scenarios[idx]+i);
if(locDiscValElem != null)
{
    locDiscValElem.innerHTML = currVal.toFixed(2);
}

tableHTML += "<td>";

id=""+this.tableId+"_discVal"+scenarios[idx]+i+i+"";

id=""+this.tableId+"_discValTotal"+scenarios[idx]+i+i+"";

return tableHTML;
}

this.setDiscountRateRow = function(idx)
{
var numRows = isNaN(this.numUsers[idx]) ? 2 : 3;
var tableHTML = '<tr><td rowspan="'+numRows+'">'+this.scenTexts[idx]+ '</td> <td>Discount rate</td> <td> <input type="number" min="0.0" max="100.0" value="'+
this.discRatesPerc[idx]+'" step="0.1" id=""+this.tableId+'_locDiscRate'+scenarios[idx]+i+i+" onchange="'+this.locCallbackName+'()" style="width: 60;">";

return tableHTML;
}
```javascript
this.setUsersNumRow = function(idx) {
    var tableHTML = '<tr>';
    tableHTML += '<td>Number of users</td>/stretchr</tr>
    for(var i = 0; i < this.monthsPeriod; ++i) {
        var currVal = this.initVals[idx][i];
        tableHTML += '<input type="number" value="' + this.numUsers[idx] + '" step="1" id="' + this.tableId + '_locUsersNum' + scenarios[idx] + i + '" onchange="this.locCallbackName()" style="width: 100;">';
    }
    tableHTML += '</tr>);

    return tableHTML;
}

this.setup = function() {
    this.yVals = [[],[],[]];
    this.parentElem.innerHTML = ""
    var tableHTML = "";
    { 
        tableHTML = '<table border="1" colspans="' + String(this.monthsPeriod+3) + '">Discounted cash flow</td><tr>;</n        // Month number
        tableHTML += '<tr>
        tableHTML += '<td colspan="2">Month</td><tr>;</n        for(var i = 0; i < this.monthsPeriod; ++i) {
            tableHTML += '<tr>
            tableHTML += '<td>' + (i+1) + '</td>""</span>
       ):
        tableHTML += '</tr>);
    }

    for(var i = 0; i < 3; ++i) {
        tableHTML += this.setDiscountRateRow(i);
        if (!isNaN(this.numUsers[i]))
            tableHTML += this.setUsersNumRow(i);
        tableHTML += this.setDiscountedValueRow(i);
    }
    tableHTML += '</table>);
}

this.update = function() {
    this.yVals = [[],[],[]];
    for(var i = 0; i < 3; ++i) {
        this.setDiscountedValueRow(i);
    }
}
```

function calcIndirectSalesRevenue()
{
    var activeUsersBegin = [
        parseFloat(document.getElementById("activeUsersPes").value),
        parseFloat(document.getElementById("activeUsers").value),
        parseFloat(document.getElementById("activeUsersOpt").value)];
    var avrgRevsUser = [
        parseFloat(document.getElementById("avrgRevUserPes").value),
        parseFloat(document.getElementById("avrgRevUser").value),
        parseFloat(document.getElementById("avrgRevUserOpt").value)];
    var salesRevsBegin = [0, 0, 0];
    for(var i = 0; i < 3; ++i)
    {
        salesRevsBegin[i] = avrgRevsUser[i] * activeUsersBegin[i];
    }
    return salesRevsBegin;
}

function calcProdAndDevCosts()
{
    var salaries = [
        document.getElementById("elemCostsSalariesPes").valueAsNumber,
        document.getElementById("elemCostsSalaries").valueAsNumber,
        document.getElementById("elemCostsSalariesOpt").valueAsNumber];
    var music = [
        document.getElementById("elemCostsMusicPes").valueAsNumber,
        document.getElementById("elemCostsMusic").valueAsNumber,
        document.getElementById("elemCostsMusicOpt").valueAsNumber];
    var devtools = [
        document.getElementById("elemCostsDevToolsPes").valueAsNumber,
        document.getElementById("elemCostsDevTools").valueAsNumber,
        document.getElementById("elemCostsDevToolsOpt").valueAsNumber];
    var engines = [
        document.getElementById("elemCostsEnginesPes").valueAsNumber,
        document.getElementById("elemCostsEngines").valueAsNumber,
        document.getElementById("elemCostsEnginesOpt").valueAsNumber];
    var hosting = [
        document.getElementById("elemCostsHostingPes").valueAsNumber,
        document.getElementById("elemCostsHosting").valueAsNumber,
        document.getElementById("elemCostsHostingOpt").valueAsNumber];
    var rent = [
        document.getElementById("elemCostsRentPes").valueAsNumber,
        document.getElementById("elemCostsRent").valueAsNumber,
        document.getElementById("elemCostsRentOpt").valueAsNumber];
    var prodAndDevCosts = [0, 0, 0];
    for(var i = 0; i < 3; ++i)
    {
        prodAndDevCosts[i] = salaries[i] + music[i] + devtools[i] + engines[i] + hosting[i] + rent[i];
    }
    return prodAndDevCosts;
}

function calcMarketingCosts()
{
    var ads = [
        document.getElementById("elemCostsAdsPes").valueAsNumber,
        document.getElementById("elemCostsAds").valueAsNumber,
        document.getElementById("elemCostsAdsOpt").valueAsNumber];
    var launch = [
        document.getElementById("elemCostsLaunchPes").valueAsNumber,
        document.getElementById("elemCostsLaunch").valueAsNumber,
        document.getElementById("elemCostsLaunchOpt").valueAsNumber];
    var conference = [
        document.getElementById("elemCostsConferencePes").valueAsNumber,
document.getElementById("elemCostsConference").valueAsNumber, 
document.getElementById("elemCostsConferenceOpt").valueAsNumber]; 

var marketingCosts = [0, 0, 0]; 
for(var i = 0; i < 3; ++i) 
{ 
    marketingCosts[i] = ads[i] + launch[i] + conference[i]; 
} 

return marketingCosts;
} 

function calcManufactCosts() 
{ 
    var manufact = [document.getElementById("elemCostsManufactPes").valueAsNumber, 
        document.getElementById("elemCostsManufact").valueAsNumber, 
        document.getElementById("elemCostsManufactOpt").valueAsNumber]; 
    var retail   = [document.getElementById("elemCostsRetailPes").valueAsNumber, 
        document.getElementById("elemCostsRetail").valueAsNumber, 
        document.getElementById("elemCostsRetailOpt").valueAsNumber]; 
    var digit    = [document.getElementById("elemCostsDigitPes").valueAsNumber, 
        document.getElementById("elemCostsDigit").valueAsNumber, 
        document.getElementById("elemCostsDigitOpt").valueAsNumber]; 

    var manufactCosts = [0, 0, 0]; 
    for(var i = 0; i < 3; ++i) 
    { 
        manufactCosts[i] = manufact[i] + retail[i] + digit[i]; 
    } 

    return manufactCosts;
} 

function calcTotalCosts() 
{ 
    var prodAndDev = calcProdAndDevCosts(); 

    var rnd      = [document.getElementById("elemCostsRNDPes").valueAsNumber, 
        document.getElementById("elemCostsRND").valueAsNumber, 
        document.getElementById("elemCostsRNDOpt").valueAsNumber]; 
    var marketing = calcMarketingCosts(); 

    var admin   = [document.getElementById("elemCostsAdminPes").valueAsNumber, 
        document.getElementById("elemCostsAdmin").valueAsNumber, 
        document.getElementById("elemCostsAdminOpt").valueAsNumber]; 
    var other   = [document.getElementById("elemCostsOtherPes").valueAsNumber, 
        document.getElementById("elemCostsOther").valueAsNumber, 
        document.getElementById("elemCostsOtherOpt").valueAsNumber]; 

    var manufact = calcManufactCosts(); 

    var totalCosts = [0, 0, 0]; 
    for(var i = 0; i < 3; ++i) 
    { 
        totalCosts[i] = prodAndDev[i] + rnd[i] + 
                        marketing[i] + 
                        manufact[i] + 
                        admin[i] + other[i]; 
    } 

    return totalCosts;
function calcCorpCulture() {
    var isUsed = document.getElementById("corporateCultureUsed").checked;
    var culture = [0, 0, 0];
    if(isUsed) {
        var aspects = ["Decision", "Leader", "Change", "Together", "Beliefs"];
        for(var k = 0; k < 3; ++k) {
            var weight = 0;
            for(var i = 0; i < aspects.length; ++i) {
                culture[k] += document.getElementById("corpCulture" + aspects[i] + "W8" + scenarios[k]).valueAsNumber *
                                document.getElementById("corpCulture" + aspects[i] + "Perc" + scenarios[k]).valueAsNumber;
                weight += document.getElementById("corpCulture" + aspects[i] + "W8" + scenarios[k]).valueAsNumber;
            }
            culture[k] = (weight == 0) ? 0.0 : (culture[k] / weight);
        }
    }
    return culture;
}

function calcSalesRevenue() {
    var rawSalesRevenues = [document.getElementById("salesRevenuePes").valueAsNumber, document.getElementById("salesRevenue").valueAsNumber, document.getElementById("salesRevenueOpt").valueAsNumber];
    var indirectSalesRevs = calcIndirectSalesRevenue();
    var salesRevenues = [0, 0, 0];
    for(var i = 0; i < 3; ++i) {
        if(isNaN(rawSalesRevenues[i])) {
            salesRevenues[i] = indirectSalesRevs[i];
        } else {
            salesRevenues[i] = rawSalesRevenues[i];
        }
    }
    return salesRevenues;
}

function calcTotalRevenue() {
    var rev = [0, 0, 0];
```javascript
var salesRevenues = calcSalesRevenue();
var otherRevs = [document.getElementById("otherRevenuePes").valueAsNumber,  
document.getElementById("otherRevenue").valueAsNumber,  
document.getElementById("otherRevenueOpt").valueAsNumber];
for(var i = 0; i < 3; ++i)  
{  
  rev[i] = salesRevenues[i] + otherRevs[i];  
}
return rev;
}

function calcFCF()  
{  
  var totalRev = calcTotalRevenue();  
  var netInvests = [document.getElementById("netInvestPes").valueAsNumber,  
                   document.getElementById("netInvest").valueAsNumber,  
                   document.getElementById("netInvestOpt").valueAsNumber];  
  var totalCosts = calcTotalCosts();  
  var culture = calcCorpCulture();  
  var monthsPeriod = document.getElementById("monthsPeriod").valueAsNumber;  
  var fcf = [0,0,0];  
  for(var k = 0; k < 3; ++k)  
  {  
    fcf[k] = totalRev[k]*(1.0+culture[k]/100.0) - netInvests[k] - totalCosts[k];  
  }
  return fcf;
} /////////////////////////////////////////////////////////////////////////////////////////////////////

var table;  
var tableSynergy;  

function updateOverallGraphs()  
{  
  if(null != table & & null != tableSynergy)  
  {  
    var monthsPeriod = document.getElementById("monthsPeriod").valueAsNumber;  
    var yVals = [[],[],[]];  
    for(var k = 0; k < 3; ++k)  
    {  
      for(var i = 0; i < monthsPeriod; ++i)  
        yVals[k].push(table.yVals[k][i]+tableSynergy.yVals[k][i]);  
    }
    drawGraph(document.getElementById("canvasOverallCashFlow"), yVals);  
    drawRealOption(yVals[0][monthsPeriod-1], yVals[1][monthsPeriod-1], yVals[2][monthsPeriod-1], document.getElementById("canvasOverallRealOption"));  
  }
  
```
function setupTable() {
    var discRatesPerc = [
        parseFloat(document.getElementById("discRatePercPes").value),
        parseFloat(document.getElementById("discRatePerc").value),
        parseFloat(document.getElementById("discRatePercOpt").value)],
    activeUsersBegin = [parseFloat(document.getElementById("activeUsersPes").value),
        parseFloat(document.getElementById("activeUsers").value),
        parseFloat(document.getElementById("activeUsersOpt").value)],
    avrgRevsUser = [parseFloat(document.getElementById("avrgRevUserPes").value),
        parseFloat(document.getElementById("avrgRevUser").value),
        parseFloat(document.getElementById("avrgRevUserOpt").value)],
    monthsPeriod = document.getElementById("monthsPeriod").valueAsNumber,
    initVals = calcFCF();
    table = new DiscountedCashFlowTable("testTable", 
        document.getElementById("discTable"),
        "onLocalDiscRateChanged",
        initVals, monthsPeriod, discRatesPerc,
        activeUsersBegin, avrgRevsUser);
    table.setup();
    drawGraph(document.getElementById("canvasCashFlow"), table.yVals);
    drawRealOption(table.yVals[0][monthsPeriod-1], table.yVals[2][monthsPeriod-1],
        table.yVals[1][monthsPeriod-1], document.getElementById("canvasRealOptionMain"));
    updateOverallGraphs();
}

function onLocalDiscRateChanged() {
    table.update();
    drawGraph(document.getElementById("canvasCashFlow"), table.yVals);
    drawRealOption(table.yVals[0][yVals[0].length-1], table.yVals[2][yVals[2].length-1],
        table.yVals[1][yVals[1].length-1], document.getElementById("canvasRealOptionMain"));
    updateOverallGraphs();
}

function updateFCF() {
    var fcf = calcFCF();
    document.getElementById("freeCachFlowPes").innerHTML = fcf[0].toFixed(2);
    document.getElementById("freeCachFlow").innerHTML = fcf[1].toFixed(2);
    document.getElementById("freeCachFlowOpt").innerHTML = fcf[2].toFixed(2);
    setupTable();
}

function updateTotalRevenue() {
    var totRev = calcTotalRevenue();
    var elemTotRev = [document.getElementById("totalRevenuePes"),
        document.getElementById("totalRevenue").valueAsNumber,
        document.getElementById("totalRevenueOpt").valueAsNumber];
    var totalRev = calcTotalRevenue();
    document.getElementById("totalRevenuePes").innerHTML = totalRev[0].toFixed(2);
    document.getElementById("totalRevenue").innerHTML = totalRev[1].toFixed(2);
    document.getElementById("totalRevenueOpt").innerHTML = totalRev[2].toFixed(2);
}
for(var i = 0; i < 3; ++i)
    elemTotRev[i].innerHTML = totRev[i].toFixed(2);

updateFCF();
}

function updateTotalCosts()
{
    var totalCosts = calcTotalCosts();
    var totalCostsElems = [document.getElementById("totalCostsPes"),
document.getElementById("totalCosts"),
document.getElementById("totalCostsOpt")].userName;

for(var i = 0; i < 3; ++i)
    totalCostsElems[i].innerHTML = totalCosts[i].toFixed(2);

updateFCF();
}

function updateDirectSalesRevenue(idx)
{
    var actUsrElems = [getEl("activeUsersPes"),
getEl("activeUsers"),
gEl("activeUsersOpt")];
var avrgRevElems = [getEl("avrgRevUserPes"),
getEl("avrgRevUser"),
gEl("avrgRevUserOpt")];

actUsrElems[idx].value = "";
avrgRevElems[idx].value = "";

updateTotalRevenue();
}

function updateIndirectSalesRevenue(idx)
{
    var salesRevenueElems = [document.getElementById("salesRevenuePes"),
doEлементById("salesRevenue"),
doElementById("salesRevenueOpt")];

    salesRevenueElems[idx].value = "";

    updateTotalRevenue();
}

function calcSynergies(elem)
{
    var salesRevenues = calcSalesRevenue();

    var prodAndDev = calcProdAndDevCosts();

    var rnd = [document.getElementById("elemCostsRNDPes").valueAsNumber,
doElementById("elemCostsRND").valueAsNumber,
doElementById("elemCostsRNDOpt").valueAsNumber];

    var marketing = calcMarketingCosts();
```
var admin = [
  document.getElementById("elemCostsAdminPes").valueAsNumber,
  document.getElementById("elemCostsAdmin").valueAsNumber,
  document.getElementById("elemCostsAdminOpt").valueAsNumber
];

var other = [
  document.getElementById("elemCostsOtherPes").valueAsNumber,
  document.getElementById("elemCostsOther").valueAsNumber,
  document.getElementById("elemCostsOtherOpt").valueAsNumber
];

var manufact = calcManufactCosts();

var baseValues = [[], [], []];
for (var k = 0; k < 3; ++k)
{
  for (var i = 0; i < 5; ++i)
  {
    baseValues[k].push(salesRevenues[k]);
    baseValues[k].push(prodAndDev[k]);
    baseValues[k].push(rnd[k]);
    baseValues[k].push(marketing[k]);
    baseValues[k].push(manufact[k]);
    baseValues[k].push(admin[k] + other[k]);
  }
}

var monthsPeriod = document.getElementById("monthsPeriod").valueAsNumber;

var synergies = [
  "RAndD", "Market", "DistrAndMan", "AdminOthers", "Finance"
];

var yVals = [[], [], []];
for (var k = 0; k < 3; ++k)
{
  for (var i = 0; i < monthsPeriod; ++i)
  {
    yVals[k].push(0.0);
  }
  for (var j = 0; j < synergies.length; ++j)
  {
    var elemSynVal = document.getElementById(
      'elemSyn' + synergies[j] + 'ProfVal' + scenarios[k]);
    var elemSynPerc = document.getElementById(
      'elemSyn' + synergies[j] + 'ProfPerc' + scenarios[k]);

    if (elem == elemSynVal)
    {
      if (elemSynPerc != null)
      {
        if (baseValues[k][j] != 0)
        {
          elemSynPerc.value = elemSynVal.valueAsNumber * 100.0 / baseValues[k][j];
        }
        else
        {
          elemSynPerc.value = 0;
          elemSynVal.value = 0;
        }
      }
    }
    else if (elem != null && elem == elemSynPerc)
    {
      elemSynVal.value = baseValues[k][j] * elemSynPerc.valueAsNumber / 100.0;
    }
  }
}
```

var profit = elemSynVal.valueAsNumber;
var startMonth =
document.getElementById('elemSyn'+synergies[j]+'ProfStartMonth'+scenarios[k]).valueAsNumber;
var endMonth =
Math.min(document.getElementById('elemSyn'+synergies[j]+'ProfEndMonth'+scenarios[k]).valueAsNumber,
monthsPeriod);
var costsStartMonth =
document.getElementById('elemSyn'+synergies[j]+'CostsStartMonth'+scenarios[k]).valueAsNumber;
var costsEndMonth =
Math.min(document.getElementById('elemSyn'+synergies[j]+'CostsEndMonth'+scenarios[k]).valueAsNumber,
monthsPeriod);
var costs =
document.getElementById('elemSyn'+synergies[j]+'CostsVal'+scenarios[k]).valueAsNumber;

for(var i = 1; i <= monthsPeriod; ++i)
{
  if(startMonth <= i && i <= endMonth)
  {
    yVals[k][i-1] += profit;
  }
  if(costsStartMonth <= i && i <= costsEndMonth)
  {
    yVals[k][i-1] -= costs;
  }
}

return yVals;

function updateSynergy(elem)
{
  var monthsPeriod = document.getElementById("monthsPeriod").valueAsNumber;
  var yVals = calcSynergies(elem);
  var discRatesSynPerc = [
    document.getElementById("discRatePercSynPes").valueAsNumber,
    document.getElementById("discRatePercSyn").valueAsNumber,
    document.getElementById("discRatePercSynOpt").valueAsNumber];

  tableSynergy = new DiscountedCashFlowTable("testTable2",
    document.getElementById("discTableSyn"),
    "onLocalSyndiscRateChanged",
    yVals, monthsPeriod, discRatesSynPerc,
    NaN, NaN);
  tableSynergy.setup();

  drawGraph(document.getElementById("canvasSynCashFlow"), tableSynergy.yVals);

  drawRealOption(tableSynergy.yVals[0][monthsPeriod-1], tableSynergy.yVals[2][monthsPeriod-1],
    tableSynergy.yVals[1][monthsPeriod-1],
    document.getElementById("canvasSynRealOption"));

  updateOverallGraphs();
}
function onLocalSynDiscRateChanged()
{
    tableSynergy.update();

    drawGraph(document.getElementById("canvasSynCashFlow"), tableSynergy.yVals);
    drawRealOption(tableSynergy.yVals[0][yVals[0].length-1],
                   tableSynergy.yVals[2][yVals[2].length-1], tableSynergy.yVals[1][yVals[1].length-1],
                   document.getElementById("canvasSynRealOption"));
    updateOverallGraphs();
}

function updateCorpCulture()
{
    var isUsed = document.getElementById("corporateCultureUsed").checked;
    setVisibility("corpCultureTable", isUsed);

    var culture = calcCorpCulture();
    var totalRev = calcTotalRevenue();

    for(var k = 0; k < 3; ++k)
    {
        document.getElementById("corpCulturePerc"+scenarios[k]).innerHTML = culture[k].toFixed(1);
        document.getElementById("corpCultureVal"+scenarios[k]).innerHTML = (totalRev[k]*culture[k]/100.0).toFixed(2);
    }
    updateFCF();
}

function drawGraph(graphCanvas, yarrays)
{
    var minTrX = 0;
    var maxTrX = 10*(yarrays[0].length+1);
    var maxY = 0;
    var minY = 0;

    for(var j = 0; j < 3; ++j)
    {
        for(var i = 0; i < yarrays[j].length; ++i)
        {
            if(yarrays[j][i] > maxY)
                maxY = yarrays[j][i];
            if(yarrays[j][i] < minY)
                minY = yarrays[j][i];
        }
    }

    var cv = graphCanvas;
    var w = cv.width;
    var h = cv.height;
    var border = 15;
    var wVirt = w-2*border;
    var top = 2*border;
    var bot = h-border;
```javascript
var oxDigY = h - 2;

var minX = Math.min(0, minTrX);
var maxX = Math.max(0, maxTrX);

var ctx = cv.getContext("2d");
ctx.clearRect(0, 0, w, h);
// OX axis
ctx.beginPath();
ctx.lineWidth = "2";
ctx.strokeStyle = "black";
ctx.moveTo(border, bot-getVirtX(0, minY, maxY, bot-top));
ctx.lineTo(w - border, bot-getVirtX(0, minY, maxY, bot-top));
ctx.stroke();
// OY axis
var oyX = border+getVirtX(0, minX, maxX, wVirt);
ctx.beginPath();
ctx.moveTo(oyX, bot);
ctx.lineTo(oyX, top - border);
ctx.lineTo(oyX - border/2, top);
ctx.moveTo(oyX, top - border);
ctx.lineTo(oyX + border/2, top);
ctx.stroke();
// 0 - axes interception
ctx.font = "12px Arial";
ctx.textAlign = "center";
ctx.fillText("0", oyX, oxDigY);
// graph
var colors = ["red", "blue", "green"];
for (var j = 0; j < 3; ++j) {
    var currX = oyX;
    ctx.beginPath();
    ctx.lineWidth = "2";
    ctx.strokeStyle = colors[j];
    ctx.moveTo(currX, bot-getVirtX(0, minY, maxY, bot-top));
    for (var i = 0; i < yarrays[j].length; ++i) {
        currX = border+getVirtX((i+1)*10, minX, maxX, wVirt);
        ctx.lineTo(currX, bot-getVirtX(yarrays[j][i], minY, maxY, bot-top));
    }
    ctx.stroke();
}
if (ctx.setLineDash) {
    var lastY = bot-getVirtX(yarrays[j][yarrays[j].length-1], minY, maxY, bot-top);
    ctx.setLineDash([10]);
    ctx.beginPath();
    ctx.moveTo(currX, lastY);
    ctx.lineTo(oyX, lastY);
    ctx.stroke();
    ctx.fillText(yarrays[j][yarrays[j].length-1].toFixed(2), oyX+35, lastY+15);
    ctx.setLineDash([]);
}
```
The first part of the analysis is a valuation of a target company as stand-alone. To estimate Free Cash Flow all known costs and revenue, annual discount rate and period are required. The inputs values should be provided for extremely pessimistic, extremely optimistic and most likely scenarios of acquisition. All inputs except annual discount rate are for monthly period. The first table requires information only for the first month and in the next table the discount rate and number of users can be changed for each month separately. ($)$ assigns inputs in monetary units.

```html
for(var i = 0; i < yarrays[0].length; ++i)
{
    currX = border+getVirtX((i+1)*10, minX, maxX, wVirt);
    ctx.beginPath();
    ctx.lineWidth="1";
    ctx.strokeStyle="rgba(200, 200, 200, 1.0)";
    ctx.moveTo(currX, top);
    ctx.lineTo(currX, bot);
    ctx.stroke();
}
</script>
</head>
<body onload="onInit()">
<div id="analysisTool">
<table id="mainTable" border="1">
<tr>
<th colspan="5">The first part of the analysis is a valuation of a target company as stand-alone.
<br>To estimate Free Cash Flow all known costs and revenue, annual discount rate and period are required. The inputs values should be provided for extremely pessimistic, extremely optimistic and most likely scenarios of acquisition. All inputs except annual discount rate are for monthly period. The first table requires information only for the first month and in the next table the discount rate and number of users can be changed for each month separately. ($)$ assigns inputs in monetary units.
</th>
</tr>
<tr>
<th colspan="2" id="elemAsset">Acquisition scenarios</th>
<th colspan="3">Analysis period (months)</th>
</tr>
<tr>
<td>Extremely pessimistic</td>
<td>Most likely</td>
<td>Extremely optimistic</td>
<td>Extremely optimistic</td>
<td>Extremely pessimistic</td>
</tr>
<tr>
<td style="text-align: left">Analysis period (months)</td>
<td style="text-align: center">Total sum of company's assets ($)</td>
<td style="text-align: center">Annual discount rate (%)</td>
</tr>
<tr>
<td style="text-align: center">Total sum of company's assets ($)</td>
<td style="text-align: center">Annual discount rate (%)</td>
<td style="text-align: center">Total sum of company's assets ($)</td>
<td style="text-align: center">Annual discount rate (%)</td>
<td style="text-align: center">Total sum of company's assets ($)</td>
<td style="text-align: center">Annual discount rate (%)</td>
</tr>
</table>
</div>
</body>
</html>
```
<tr>
  <td colspan="2">Number of monthly active users</td>
  <td><input type="text" id="activeUsersPes" onchange="updateIndirectSalesRevenue(0)"
 style="width: 100;"/>
  </td>
</tr>
<tr>
  <td colspan="2">Average revenue per user ($)</td>
  <td><input type="text" id="avgRevUserPes" onchange="updateIndirectSalesRevenue(0)"
 style="width: 100;"/>
  </td>
</tr>
<tr>
  <th colspan="2" style="text-align: left">Revenue from game sales ($)</th>
  <td><input type="number" min="0" max="1000000" value="0" id="salesRevenue" onchange="updateDirectSalesRevenue(0)"
 style="width: 100;"/>
  </td>
</tr>
<tr>
  <th colspan="2" style="text-align: left">Revenue from other sources ($)</th>
  <td><input type="number" min="0" max="1000000" value="0" id="otherRevenue" onchange="updateDirectSalesRevenue(1)"
 style="width: 100;"/>
  </td>
</tr>
<tr>
  <th colspan="2" style="text-align: left">Net investments in operating capital</th>
  <td><input type="number" min="0" max="1000000" value="0" id="netInvest" onchange="updateIndirectSalesRevenue(2)"
 style="width: 100;"/>
  </td>
</tr>
<tr>
  <th colspan="2" style="text-align: left">TOTAL REVENUE ($)</th>
  <td><input type="number" min="0" max="1000000" value="0" id="totalRevenue" onchange="updateTotalRevenue()"
 style="width: 100;"/>
  </td>
</tr>
<tr>
  <th colspan="2" style="text-align: left">Production and development costs ($)</th>
  <td><input type="number" min="0" max="1000000" value="0" id="productionCost" onchange="updateFCF()"
 style="width: 100;"/>
  </td>
</tr>
<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
<th>Column 5</th>
<th>Column 6</th>
<th>Column 7</th>
<th>Column 8</th>
<th>Column 9</th>
<th>Column 10</th>
<th>Column 11</th>
<th>Column 12</th>
<th>Column 13</th>
<th>Column 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice actors, music</td>
<td>1000000</td>
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<td>Development tools</td>
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<td>Game engines</td>
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<td>Servers hosting / Cloud computing</td>
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<td>Equipment rent</td>
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<tr>
<td>R&amp;D</td>
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</tr>
</tbody>
</table>
<table>
  <tr>
    <th colspan="2" style="text-align: left">Retail distributions</th>
  </tr>
  <tr>
    <td><input type="number" min="0" max="1000000" value="0" id="elemCostsRetailPes" oncharge="updateTotalCosts()" style="width: 100%;"></td>
    <td><input type="number" min="0" max="1000000" value="0" id="elemCostsRetailOpt" onchange="updateTotalCosts()" style="width: 100%;"></td>
    <input type="number" min="0" max="1000000" value="0" id="elemCostsRetail" onchange="updateTotalCosts()" style="width: 100%;"></td>
  </tr>
  <tr>
    <th colspan="2" style="text-align: left">Manufacturing costs</th>
  </tr>
  <tr>
    <td><input type="number" min="0" max="1000000" value="0" id="elemCostsManufactOpt" oncharge="updateTotalCosts()" style="width: 100%;"></td>
    <td><input type="number" min="0" max="1000000" value="0" id="elemCostsManufact" onchange="updateTotalCosts()" style="width: 100%;"></td>
    <input type="number" min="0" max="1000000" value="0" id="elemCostsManufactPes" onchange="updateTotalCosts()" style="width: 100%;"></td>
  </tr>
  <tr>
    <th colspan="2" style="text-align: left">Conferences</th>
  </tr>
  <tr>
    <td><input type="number" min="0" max="1000000" value="0" id="elemCostsConferencePes" onchange="updateTotalCosts()" style="width: 100%;"></td>
    <td><input type="number" min="0" max="1000000" value="0" id="elemCostsConferenceOpt" onchange="updateTotalCosts()" style="width: 100%;"></td>
    <input type="number" min="0" max="1000000" value="0" id="elemCostsConference" onchange="updateTotalCosts()" style="width: 100%;"></td>
  </tr>
  <tr>
    <th colspan="2" style="text-align: left">Launch parties</th>
  </tr>
  <tr>
    <td><input type="number" min="0" max="1000000" value="0" id="elemCostsLaunchPes" onchange="updateTotalCosts()" style="width: 100%;"></td>
    <td><input type="number" min="0" max="1000000" value="0" id="elemCostsLaunchOpt" onchange="updateTotalCosts()" style="width: 100%;"></td>
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  </tr>
  <tr>
    <th colspan="2" style="text-align: left">Advertisements</th>
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  <tr>
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  <tr>
    <th colspan="2" style="text-align: left">Marketing and promotions costs ($)</th>
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    <th colspan="2" style="text-align: left">Digital distribution</th>
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### Operating Costs ($)

<table>
<thead>
<tr>
<th>Decision-Making</th>
<th>Operational Costs ($)</th>
<th>_other Costs ($)</th>
<th>Free Cash Flow ($)</th>
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</table>

This optional section determines impact of corporate culture on target company's revenue as a percentage change. Total impact is a weighted average of parameters grades. Weights could be chosen from 0 to 10.
<table>
<thead>
<tr>
<th>Corp Culture Together Perc Opt</th>
<th>Corp Culture Together Perc</th>
<th>Corp Culture Change W8 Perc Opt</th>
<th>Corp Culture Change W8 Perc</th>
<th>Corp Culture Leader W8 Perc Opt</th>
<th>Corp Culture Leader W8 Perc</th>
<th>Corp Culture Decision W8 Perc Opt</th>
<th>Corp Culture Decision W8 Perc</th>
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</tbody>
</table>

*How people work together*

*Ability to change*

*Leadership style*
<table>
<thead>
<tr>
<th>Personal success/Team work</th>
<th>50.0%</th>
<th>60.0%</th>
<th>70.0%</th>
<th>80.0%</th>
<th>90.0%</th>
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</tbody>
</table>

Cummulative Discounted Free Cash Flow

Pay-off distribution of target's value as a stand-alone company

Table for synergy impact on revenue ($):
The second part of the analysis is potential synergies valuation. This section requires the value of synergy's revenue as percentage or as monetary value, discount rate, start and end month (duration) and monthly costs. Synergies from increasing revenue are linked to target as stand-alone total revenue and synergies from costs reduction are similarly linked to corresponding costs.

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Extremely pessimistic</th>
<th>Most likely</th>
<th>Extremely optimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual discount rate (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Synergies from increased revenue

Synergies from cost reduction

Balance-sheet synergies

Cumulative Discounted Synergies Cash Flow

Pay-off distribution of potential synergies

Cumulative Discounted Total Free Cash Flow (Stand-alone and Synergies)
<canvas id="canvasOverallCashFlow" width="600" height="300" style="border:1px solid #ccc"/>
</div>
<br>Pay-off distribution of Total target company's value (Stand-alone and Synergies)<br>
<canvas id="canvasOverallRealOption" width="600" height="300" style="border:1px solid #ccc"/>
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</body>
</html>