St. Petersburg University
Graduate School of Management

Master in Corporate Finance

VALUATION OF PRODUCT LINE EXTENSION SUCCESS: AIRBUS AND BOEING CASE

Master's Thesis by the 2nd year student
Concentration – Master in Corporate Finance
Milana Bubyakina

Research advisor:
Associate professor Anna Loukianova

St. Petersburg
2017

ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

Я, Бубякина Милана Александровна, студент второго курса магистратуры направления «Менеджмент», заявляю, что в моей магистерской диссертации на тему «Оценка успеха расширения продуктовой линейки: пример Airbus и Boeing», представленной в службу обеспечения программ магистратуры для последующей передачи в государственную аттестационную комиссию для публичной защиты, не содержится элементов плагиата.

Все прямые заимствования из печатных и электронных источников, а также из защищенных ранее выпускных квалификационных работ, кандидатских и докторских диссертаций имеют соответствующие ссылки.

Мне известно содержание п. 9.7.1 Правил обучения по основным образовательным программам высшего и среднего профессионального образования в СПбГУ о том, что «ВКР выполняется индивидуально каждым студентом под руководством назначенного ему научного руководителя», и п. 51 Устава федерального государственного бюджетного образовательного учреждения высшего образования «Санкт-Петербургский государственный университет» о том, что «студент подлежит отчислению из Санкт-Петербургского университета за представление курсовой или выпускной квалификационной работы, выполненной другим лицом (лицами)».

_____ (Подпись студента)

31.05.2017

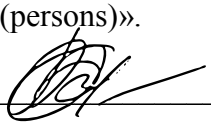
_____ (Дата)

STATEMENT ABOUT THE INDEPENDENT CHARACTER OF
THE MASTER THESIS

I, Bubyakina Milana, second year master student, program «Master in Corporate Finance», state that my master thesis on the topic "Valuation of Product Line Extension Success: Airbus and Boeing Case", which is presented to the Master Office to be submitted to the Official Defense Committee for the public defense, does not contain any elements of plagiarism.

All direct borrowings from printed and electronic sources, as well as from master theses, PhD and doctorate theses which were defended earlier, have appropriate references.

I am aware that according to paragraph 9.7.1. of Guidelines for instruction in major curriculum programs of higher and secondary professional education at St. Petersburg University «A master thesis must be completed by each of the degree candidates individually under the supervision of his or her advisor», and according to paragraph 51 of Charter of the Federal State Institution of Higher Education Saint-Petersburg State University «a student can be expelled from St. Petersburg University for submitting of the course or graduation qualification work developed by other person (persons)».



_____ (Student's signature)

31.05.2017

_____ (Date)

АННОТАЦИЯ

Автор	Бубякина Милана Александровна
Название магистерской диссертации	«Оценка успеха расширения продуктовой линейки: пример Airbus и Boeing»
Факультет	Высшая Школа Менеджмента
Направление подготовки	Корпоративные финансы
Год	2017
Научный руководитель	Лукьянова А.Е.
Описание цели, задач и основных результатов	Цель: оценить успешность стратегии расширения продуктовой линейки на примере Airbus и Boeing Задачи: 1. Проанализировать бренд стратегии, в частности стратегию расширения продуктовой линейки; 2. Проанализировать современные инструменты оценки бренд стратегий; 3. Обосновать выбор инструмента оценки; 4. Провести обзор выбранных компаний; 5. Проанализировать проекты расширения продуктовой линейки с помощью стандартных инструментов; 6. Проанализировать проекты расширения продуктовой линейки с помощью реальных опционов; 7. Сделать выводы и рекомендации на основании проведенного исследования. Основные результаты. Стратегия расширения продуктовой линейки подразумевает выпуск нового продукта с некоторыми видоизменениями. Он может рассматриваться как инвестиционный проект, оценка которого производится с помощью финансовых инструментов. В качестве методологии был выбран анализ через реальные опционы. Данный инструмент является наиболее приемлемой для оценки долгосрочных проектов с высоким уровнем риска. Один из результатов данного исследования заключается в том, что, несмотря на доминирование Boeing на рынке авиастроения, Airbus постепенно переигрывает своего конкурента. Анализ проектов показал, что проект Airbus наиболее успешен по сравнению с конкурентом, что еще раз доказывает преимущество европейской компании. Более того, компании могут использовать методику реальных опционов для оценки успешности проектов и их сравнении с конкурентами.
Ключевые слова	Реальные опционы Бренд стратегии Авиастроение

ABSTRACT

Master Student's Name	Bubyakina Milana
Master Thesis Title	"Valuation of Product Line Extension Success: Airbus and Boeing Case"
Faculty	Graduate School of Management
Main field of study	Corporate Finance
Year	2017
Academic Advisor's Name	Loukianova A.E.
Description of the goal, tasks and main results	Goal: To evaluate success of product line extension strategy implementation on the example of Airbus and Boeing Objectives: 1. To analyze brand strategies, particularly, the strategy of product line extension; 2. To analyze contemporary tools of the brand strategy assessment; 3. To justify the choice of the valuation tool; 4. To make an overview of the chosen companies; 5. To evaluate product line extension projects with the help of standard tools; 6. To evaluate product line extension projects with the help of real options analysis; 7. To draw conclusions and recommendations based on the conducted research. Main results. Product line extension strategy assumes launch of a new product with slight changes. It can be viewed as a typical investment project, which can be assessed using financial tools. The real option analysis (ROA) has been chosen as a reasonable and applicable tool for analysis of product line extension strategy in aircraft production industry. The research results revealed that even despite long-term dominance of Boeing on the market, Airbus starts to outperform its rival. The new Airbus project turned to be more successful, which once again proves the advantage of the European company. Furthermore, companies like Airbus and Boeing can use ROA methodology as a tool for projects' success valuation and comparison with competitors.
Keywords	Real option analysis Brand strategies Aircraft production industry

Contents

Introduction

Nowadays, in times of high competitiveness, breakthroughs and Internet development it becomes more and more difficult for companies to satisfy consumers' needs. Currently, people can easily access any Internet source and have any product's information they need. This trend reduces consumers' necessity to go shopping and makes them high price sensitive, since there is almost perfect information transparency and availability. Due to his, companies lose their power over consumers as well as their loyalty, because now people can shop online, find any products they like as well as compare them between each other. This spurs companies to use various strategies in order to keep consumers' attention and spur their interest to goods and services. One of the most effective ways is to build a strong well-recognized brand and try to establish a long-lasting loyalty. To do so organizations try to use their major brand and issue various products with differentiated features in many segments so to keep attention and try to get rid of competitors This strategy is called brand extension. The most popular type of brand extension is product line extension. It is relatively cheap, does not require high investments as well as not that risky as a new product introduction. Major examples of successful strategy implementation are Coca Cola with its Vanilla and Diet Coke, Apple with iPhone 5se, Samsung with its A-series and many other examples of FMCG and IT sectors.

One can notice that this strategy is widely used, however the universality and efficiency of this strategy is under a question since it might not be that successful as any other strategy. Hence, in this paper the author will evaluate success of product line extension strategy implementation on the example of Airbus and Boeing and draw conclusion, based on research.

Topicality of this paper related to the fact that there is big attention to the use of qualitative or, in other words, judgmental tools for success valuation, which are easier to implement, since they do not require additional knowledge and expertise. Since, any new product launch can be viewed as an investment project, it is necessary to use more complex instruments, which can give more accurate and holistic valuation of the investment option.

The goal of this paper is to evaluate and compare success of product line extension projects on the example of Airbus and Boeing.

Core objectives of this paper are:

1. To analyze the brand strategies, particularly, the strategy of product line extension;
2. To analyze contemporary tools of the brand strategy assessment;
3. To justify the choice of the valuation tool;
4. To make an overview of the chosen companies;
5. To evaluate product line extension projects with the help of standard tools;
6. To evaluate product line extension projects with the help of real options analysis;

7. To draw conclusions and recommendations based on the conducted research.

For the master thesis, the researcher used data from following sources: official websites of Airbus and Boeing, their annual presentations, press releases and articles related to aircraft production industry, industry reports, books and articles related to the tool used in the paper.

Core methodology, which was applied to the research, was Real Option Analysis.

The structure of the research corresponds to the stated objectives and follows next steps:

1. Chapter 1 is devoted to the overview of brand strategies: types, characteristics, their applicability. In this part, the researcher focuses mainly on such strategy as product line extension, which is widely-used nowadays. Apart from this, the researcher provides a detailed analysis of tools, used for strategy success valuation. It was observed that nowadays judgmental means are of higher popularity than quantitative ones.
2. Chapter 2 covers the justification of tool choice for further research. The researcher choses Real Option Analysis as a core instrument for product line extension strategy analysis. Additionally, the choice of a case will be provided: the author of this paper focuses on aircraft production industry, since there is indeed lack of academic analysis in terms of success of the considered strategy in the air transport sector.
3. Chapter 3 is related to the description of core findings of the analysis. Here the researcher will provide core insights of chosen projects and their success results comparing to each other.

In the part of Managerial implication, the author will summarize all results and make final recommendations and conclusions. In the part of conclusion, the researcher will summarize all findings, obtained during the whole research.

Chapter 1. Overview of brand strategies and their valuation

1.1. Definition of brand and brand strategy

Currently all organizations are operating in a very dynamic environment: there are changes not only in market conditions, but also in competition and consumers' behavior. As for organizations themselves, in times of open markets and active internalization strategies the number of companies is growing from year to year. This trend is related not only to IT companies, whose products are in major demand, but also to other industries, both big or small. For instance, currently there are numerous new companies, starting their operations in industries such as car manufacturing or health care. Another aspect of current business state is the size of companies. Not only are there big corporations like Apple or Google, but also a lot of small multimedia enterprises (SMEs) and small start-ups, acting both locally and globally.

Considering consumers' side, one can conclude that this part has also changed dramatically: it became difficult to satisfy needs of both physical and legal entities. With the development of technologies, people obtained access to all information about descriptions and prices. Consequently, there is no longer a need to visit a store and search for information about a product he or she is willing to buy. Hence, retailers are losing their position as information providers for consumers. Additionally, internet development led to a boost of growth in eCommerce, thereby significantly changing customers' behavior. They tend to purchase more and more online rather than in conventional shops. Moreover, e-shops provide lower prices, hence, making e-shopping more attractive. Lower prices in combination with increased transparency about product specification led to lower customer loyalty. Now clients have one task: finding the best offer either with the lowest prices or a brand that would be trustful and provide the highest value.

With these significant shifts in the business world, it became crucial to keep up with changes in demand, technologies and trends to be profitable and outperform other players on the market. Here, one can understand that sales of products with no brand recognition might be unsuccessful, and it is important to pay attention to a company's performance and distinction from other players (Kapferer, 2012). There are several popular tools: logos, symbols, designs and other attributes which help to differentiate companies from other players and somehow create and sustain customers' loyalty. This set of tools is called "brand". This term has been recently reviewed by numerous researchers.

The term "brand" is a widely-discussed notion and has different meanings. *Brand* can be described as "a name, term, sign, symbol, design, or a combination of them intended to differentiate one product from those of the competitors" (Waseem, 2014). Additionally, brand

can be perceived not only as a differentiator from other market products but also as a source of a product (Sullivan, 1998). Aaker (1991, 7 p.) states that brand is "a distinguishing name and/or symbol (logo, trademark, package design) intended to identify the goods or services of either one seller or a group of sellers, and to differentiate those goods or services from those of competitors". Apart from these academic points of view, Cheverton (2006) states that brand is not limited to a name heavily promoted on the market. It should represent a unique idea, which makes the brand alive, grow and develop. Another definition of a brand is the following: "a set of mental associations, held by the consumer, which add to the perceived value of a product or service" (Keller, et al., 1998).

A brand itself cannot be successful as it is. Instead, it should correspond to market dynamics, consumers' needs and other criteria. Keller (2000) in his work "The brand report card" pointed out ten core characteristics of a successful brand:

- **Providing clients with positively perceived product and services.** Keller states an example of Starbucks, which is one of the most successful brands nowadays. This company started with offering high quality coffee to clients as a major product. Additionally, the company, understanding clients' necessity for a place to meet and talk, also payed attention to interior design. Excellent coffee along with a cozy atmosphere made the brand one of the most recognizable and successful on the market.
- **Brand relevance.** In times of rapidly changing consumption needs and preferences, it is important to keep up with these changes to maintain the brand on a high level. In this context, brand relevance stands for the ability to be flexible.
- **Pricing is aligned with value, perceived by customers.** Alignment of value and price is an important issue. Only if a client feels that a proposed price is suitable for all characteristics and value a product has, he or she might buy it. If this is not the case, a brand might be perceived overpriced and not demanded.
- **Effective positioning.** Successful brands are those which succeeded in getting a special place in the customers' conscience. This perception should be associated with a particular set of a product's benefits.
- **Brand consistency.** Brand consistency is crucial for branding, since it stands for stability of a brand offering. Consistency requires that consumers are not puzzled by changing the brand offering too frequently.
- **Reasonable hierarchy of brand portfolio.** Many companies have not one, but a set of brands, and it is important that the brands' presentation is logical and understandable for a client.

- **Coordinated support.** Clients can get information about brands from different sources. Hence, a company should use different tools to support its brand on the market.
- **Understanding of brand value for customers.** The success of a brand becomes possible when managers understand the brand value as perceived by clients.
- **Proper long-term support.** To achieve success a brand should get an all-sided support, not from only one department, but also from others.
- **Monitoring of brand equity sources.** A comprehensive monitoring system provides top management with a possibility to assess different aspects of brand, which sometimes need to be corrected or changed to get higher market positions.

De Chernatony (2010) emphasizes that apart from these 10 characteristics, there should be a systematic approach to business plan creation to be able to control for further brand development. In many companies, managers develop not just a business plan, but also a brand strategy with a full description and details of the further steps of brand evolution. In recent articles, researchers define brand strategy as a long-term plan of action for successful product development targeted at achieving specific goals (Gunelius, 2013).

1.2. Brand strategies' classification

Concerning types of strategy, there is no unilateral opinion. There are numerous classifications with respect to different stages of product life cycle. Starting with the first stage of brand development, researchers define 10 types of strategies (Gupta, 2009).

Company's name. Creation of a strong company's name becomes a driver for the products' or a subsidiary's success.

Individual Branding. The name of a strategy already speaks for itself: a company uses separate brand names for different products. This allows a company not to puzzle customers with one brand and different quality levels. Here, customers are attached to a particular brand name. Thanks to this, companies are free to vary quantity and characteristics, with lower risks to a main brand.

Attitude Branding. This strategy targets not only the functionality of products, but even more – the personal attachment to a brand: identity and self-expression. The milestone representative of this strategy is Apple.

"**No-brand" Branding.** This type of branding means that a product is noticeable to consumers with no use of a special brand name. One of several ways to do it, is the creation of a special packaging which emphasizes simplicity of the product.

Derived Brands. The derived brands strategy is used to promote a product which is a component of another product but which should still be noticeable on the market. An outstanding example of this approach is Intel.

Brand Extension. This particular strategy implies that companies extend the number of products they produce. Usually, these goods are not significantly different from already existing ones. However, they can have different brand names, slightly different characteristics as well as be presented in other product segments. This strategy indeed became one of the most popular ones, but it bears big risks in terms of brand perception and oversegmentation.

Multi-branding strategy. Having multiple brands in a portfolio can be an effective way to compete against other players. The main rationale is that having more brands allows to get a bigger market share comparing with having only one brand. Procter & Gamble is a leader of using this strategy: it has ten different detergent brands. This raises the opportunity to get more shelf space and increase consumers' attention. The biggest risk of this type of strategy is internal cannibalization between brands.

White labels. This particular approach is widely used by retailers. Retailers try to create their own brands of goods being sold in their stores. These so called "white" or "private" labels are intended to compete with conventional brands. These can even outperform well-established ones, sometimes due to pricing: white labels are usually cheaper.

Individual and Organizational Brands. This strategy assumes that individuals and organizations can be branded. Personal branding covers brand creation for a person such as faith branding – religious attributes and organizations.

Crowdsourcing Branding. Crowdsourcing branding is an opposite approach to the strategies above. Here, people create a brand for a company. This strategy helps to mitigate initial risks, because the brand is created in a bottom-up approach and all the changes and disagreements concerning it are done by society.

From these strategies, brand extension became very popular among companies with widely-known brands and loyal clients. Numerous examples of organizations, who use this strategy, are presented in all industries but mainly in fast-moving consumer goods (FMCG), automotive and IT industries. Among the most successful implementers are Unilever, Procter & Gamble, BMW, Mercedes Benz, Apple, Samsung. Due to popularity of brand extension, it was decided to concentrate on this strategy.

In turn brand extension strategy can be also segmented in different types. One of the most famous ways to do so was proposed in a paper "Brand Franchise Extension: New Product Benefits from Existing Brand Names": there are four core strategies of brand development (Tauber, 1981):

Table 1. Types of brand strategies

		Product Category	
		New	Existing
Brand name	New	New Product	Flanker Brand
	Existing	Franchise Extension	Line Extension

New Product

New product strategy assumes development and introduction of a new product with a new brand name as well as in a new product category. In other words, this strategy can also be called product diversification and can be explained as a new market penetration. This approach is used when a company wants to expand its activity beyond existing segments and markets, trying to capture more clients. Diversification can be either related or unrelated. This means that companies can enter markets and segments which can be connected with main activity or it can be a totally new sphere.

Undoubtedly, this strategy has numerous benefits:

1. Opportunity to increase of market share thanks to existing clients' loyalty;
2. Opportunity to increase profits from running different products;
3. Decrease of risks due to different markets characteristics (case of unrelated diversification)

Apart from advantages, this strategy has several limitations:

1. Significant investments in diversification;
2. Higher risks due to possible lack of experience and knowledge in a chosen segment;
3. In case if diversification is unrelated, then there is no complementarity among products, leading to lack of synergies;
4. Threat of damage to existing products: lack of attention, investments, improvements.

Flanker Brand

Flanker Brand stands for introduction of a new brand name on the market in already existing product segment. This strategy is to issue create a new brand that will be competing with already existing products, but with no market share cannibalization. This is achieved through targeting different client groups. This strategy is also called a multibranding strategy, since a company uses several brand names on the same market. (Giddens, et al., 2010 a) When companies use this approach, usually they have following types of products:

1. Premium product with higher price and quality;
2. One and more products with lower price and quality or different set of benefits.

Flanker brand strategy is indeed important. By using couple of brands a company gets potential to capture more clients from different segments. While the main brand is aimed at majority of clients, another brand can be aimed at attracting and converting clients from one segment to another. For instance, P&G has a very successful brand "Tide", a laundry detergent. Recently they introduced a cheaper type of detergent called "Cheer", aimed at a lower price segment. Even though the demand on Tide declined, the overall turnover from two detergents were much higher comparing to the one brand performance.

Flanker brand strategy has numerous advantages for companies:

1. Targeting different segments with different brands helps to embrace more clients;
2. Attraction of more clients gives opportunity to increase market share;
3. Possible brand's association with a company's name can increase clients' loyalty;
4. Possibility to get more shelf space in stores, by this increasing presence in stores;
5. New brand name helps to protect company: new brand is not quickly associated with a company's name, hence, in case of failure the risk for a company will be lower;
6. Possibility to achieve economy of scale though production of similar products.

However, this strategy is not universal and cannot be used in all cases. It has several limitations to be considered by companies before use:

1. Flanker brand strategy requires heavy investments in new brand development (creation, strategy, promotion, control) and implies high risks;
2. Flanker brand strategy can lead to internal cannibalization. This means that new brand starts to decrease market share and sales of a primary brand;
3. Flanker brand strategy can lead to loss of strategic focus. This means that a company, having numerous brands, cannot intensively control the whole portfolio, hence possibly losing quality of branding.

Franchise Extension

Franchise extension strategy stands for a use of an existing brand to enter a product category, which is new for a company. The popularity of this strategy was driven by companies' willingness to use cost-efficient ways of branding. Given an established loyalty along with brand recognition companies obtained an efficient way to increase their presence. Pitta et al. (1995) state that companies can be indeed tempted by opportunity to use results of product development and promotion for their primary products. As an evidence to this statement, different researches

proved that franchise extensions were more cost-saving in terms of marketing comparing to new brand strategy (Pitta, et al., 1995).

Franchise extension strategy can be also named as an umbrella strategy. This means that companies use their brand names in all segments, where they want to work. In this case, companies can use existing advertising channels and resources, brand names and other established capabilities. Thanks to these benefits, companies can avoid additional expenditure on marketing as well as increase brand equity and loyalty.

Franchise extension strategy has numerous advantages for companies:

1. Possibility to get more so called more shelf space in stores, by this increasing presence in stores;
2. Possibility to achieve bigger market share;
3. Cost efficiency due to use of established and well-renown marketing channels;
4. Possibility to reduce potential risk.

Without any doubt, this strategy has a lot of benefits, however it has several limitations to be considered by companies before use:

1. Dilution of brand image on the market due to spread over numerous segments;
2. Brand cannibalism;
3. Potential to harm the image of a whole brand name in case of failure.

Line Extension

Brand line extension strategy is when a company uses its existing brand to introduce a new product, which has slightly different characteristics, in already existing product segment. Even though products have different characteristics, the success of a new one relies heavily on success of the core item (Giddens, et al., 2010 b).

This strategy is very popular nowadays: big companies use their established brands to gain maximum from markets: packages, flavors, sizes, components, etc. Why do companies frequently use this option? Line extension strategy helps to reduce risks, connected with product line development because there is already an established recognizable brand, so investments for promotion and development are lower and potential for success is higher. Additionally, brand line extension gives opportunity to expand shelf space in stores, by this increasing brand recognition. All benefits of this strategy are summed up below:

1. Expand company shelf space presence;
2. Gain more potential customers;
3. Offer customers more variety;
4. Greater marketing efficiency;
5. Greater production efficiency;

6. Lower promotional costs;
7. Increased profits.

However, despite having a lot of benefits, this approach has several limits:

1. Potential for failure, which may damage products within the brand

   If a new line extension fails to satisfy, consumers' attitudes toward other products carrying the same brand name may be damaged.

2. Possible intra-firm competition

   Since line extension strategy assumes creation of quite similar products, they might target similar clients' groups, starting an internal competition between goods. It is crucial to be able to differentiate products in a clear way.

1.3. Product line extension strategy overview

1.3.1. Justification for product line extension popularity

All strategies, mentioned above, are widely used by companies with one purpose – to get as many clients as possible as well as increase profits. However, the most popular one is product line extension. Within last 15 years, companies flooded markets with products and services in majority of segments and niches. Coca-Cola primarily produced original Coke, however later introduced Diet Coke as well as Vanilla Coke. Both products have slightly different attributes and characteristics comparing to the original product: Diet Coke contains less sugar while Vanilla Coke has a Vanilla flavor. Colgate, the producer of toothpastes, also introduced different versions of their product with different flavors and functions: whitening, for enamel, for flush, etc. Going further along FMCG sector here one can concentrate on detergents: Tide has products for wool, cotton, colored clothes, white clothes. So, a consumer can observe numerous products, which are slightly different in terms of qualities but still are in the same segments and under the same brand.

The main question arises here is why so many companies pursue this strategy. According to numerous researches, there are several reasons to that.

Customer segmentation. Product line extension is perceived as low-risk, low-cost strategy. Thanks to less investments in branding strategy and investigations companies can identify needs and segments more efficiently. Additionally, using extension they may get more clients from various price segments and increase their profitability.

Customer needs. There are numerous types of customers with respect to their purchasing behavior. One of these types is a type which refers to people who tend to switch brands. Playing with quality, prices or characteristics companies are able to satisfy more clients with different needs. Additionally, there are impulse purchasers who do not pay attention to a particular brand.

Here, companies, which use strategy of line extension, have more shelf space and thus have more chance to sell a product.

Pricing variety. Another reason is to target different pricing segments. Selling premium products with higher prices allows companies to benefit from increased profits even despite possible internal cannibalization between products. Another option is to introduce cheaper items and benefit from increased audience of clients.

Excess capacity. Other reason to practice line extension may be presence of available production capacity. Increasing quantity of goods produced companies can increase overall efficiency: decreased costs per unit produced, increased quality. This is possible especially if a new product does not require extra changes in the design or construction.

Short-term profits. Since line extension assumes that a new good is not significantly different from a core product, a company does not need to invest a lot in design and production. Hence, this strategy provides with an opportunity to benefit from short-term gains from sales of a new item under low risk.

Competition intensiveness. Line extensions can also serve as a tool for a competition tool against other players. Increasing number of goods produced with slight changes increases the presence on the market in terms of shelf space. This helps to conquer consumers' attention and outperform competitors. A famous example is a battle between Crest and Colgate. Both companies have toothpastes with different flavors in different packages to increase their presence, market share and not let other brands enter the market.

Trade pressure. Line extension might be caused by a trade situation. For instance, different trade accounts might demand special package size of a good or a differentiated product with different characteristics so to fit pursued marketing strategies. This fact influences goods producers, so they need to produce different versions of goods in order to fulfill the demand. However, this situation leads to a goods comparison impediment for clients: products might be the same but packages are different so consumers are less able to compare goods.

Should researchers emphasize that proliferation of product lines is not that beneficial as it may seem at a first glance. Unfortunately, this strategy has certain limitations and pitfalls which are to be considered by companies before implementation.

Oversegmentation. The dilution of products can lead to a situation of oversegmentation: managers cannot explain purpose of each item, so retailers start to rely on their internal information, do purchases of products based on their analysis, so managers lose control over the product line. Additionally, excess segmentation of product line can make consumers confused and less interested in products.

Low brand loyalty. Brand extension can lead to decrease in brand loyalty. Firstly, having a vast choice of products consumers can start to search for more options, leading to switching between products and brands. Secondly, having either shift up and down in terms of quality and pricing customers can lose interest in a brand.

Underexploited ideas. Some product ideas are too big to be realized while brand extension is done with lower risks and investments. This can lead to company's stagnation and slower pace of development in long-term perspective.

Stagnating demand. Via increase in number of goods produced companies, unfortunately, they do not create additional demand for their products. Hence, products proliferation can easily lead to demand stagnation.

1.3.2. Product line extension classification

The strategy of product line extension can be segmented more precisely. Product line can be either horizontal or vertical. Here the main criteria for distinction are price and quantity. In case of horizontal type, a company keeps prices and quantity on the same level but changes characteristics such as color or flavor so to differentiate goods. The opposite version of product line extension assumes that prices and quantity can be either increased or decreased by this creating either luxury products or low-priced. In both horizontal and vertical product line extensions products are similar to some extent and target various clients' segments.

Vertical product line extension can be also split into up and down stretching by varying pricing parameter. In case of up stretching, companies may try to target high-end markets and segments. Main target here is to get an image of a full-line producer. Via an up stretching a company can increase the number of customers, who belong to a middle class, willing to pay more for quality and brand. One of the main advantages for a company is an ability to adjust their pricing strategy according to the changing environment with no harm to the image. Additionally, due to higher prices for "luxury" products companies may benefit from higher profitability. Best examples of upward extension are Starbucks, which was previously a coffee shop, Evian, which turned to be premium bottle water producer. Additionally, one can consider an automotive industry with Toyota, which introduced Lexus as a luxury brand, or Nissan with Infiniti. Even though these two companies introduced new brand names, still products are in the same product segments as well as brand names are still perceived from main companies' side. Upward extension for sure has advantages, however introduction of new exclusive products has limitations. Cheaper brands or products can be more popular and keep attention and demand, while expensive ones may not create any value for a company. Moreover, consumers can be puzzled with quality level of more expensive items and doubt in their value.

As for down stretching, the situation is opposite: a middle-class company tries to conquer lower-priced markets and segments. The reasons for this strategy choice can be different. At first, shift to the lower markets can be driven by possible recession in middle class market. Secondly, low-priced segment may contain more consumers, so downward extension gives a chance to capture this part. Third reason can be related to the willingness of a company to play out nearest competitors through challenging them with this shift. Concerning benefits of this strategy, firstly, it gives access to higher number of consumers, who prefer to buy value-based products. Secondly, more cheaper products increase competition on the market, and that is beneficial especially if a company has a price advantage over competitors. Thirdly, the image of a middle-priced brand may increase popularity of products since it still retains a perception about quality. Widely known examples of this strategy are Apple with its iPhone 5c and iPhone 5se and Samsung with A-series. Both companies introduced cheaper versions of their flagship smartphones in order to target lower priced segments and capture more consumers. Despite benefits, this strategy may be dangerous for a parent brand. Introduction of a cheaper products may decrease the image of a brand itself. In a paper "Downward Price-Based Brand Line Extensions Effects on Luxury Brands" authors revealed the fact that when a high-status brand practices downward extension, customers "might perceive a luxury brand … as dishonest and not trustworthy" (Royo-Vela, et al., 2015). However, this influence mainly depends on the market and segment where a company operates. In case of Walmart's down stretching strategy, the company was able to increase profits, however that was achieved thanks to the already existing image of a low-priced store.

1.4. Overview of product line extension valuation tools

A new product launch is surely aimed at achievement of higher profits and extension of customers' base. Having promised such ambitious results, new product introduction is not a risk-free activity. When a company decides to introduce a new product to a market, undoubtedly it will face a lot of uncertainty and risks. All these factors have both internal and external direction. With no research and calculations an organization might not know how clients will react on it, what levels of sales a company will achieve, whether the whole project will be successful. Moreover, all organizations are facing dramatic economic uncertainties, which also have a substantial influence on a product's performance. But before any launch a company goes through a long journey of a product development: design, pricing, supply, marketing, distribution, etc. All these steps at this stage already encounters enormous investments, spent time and efforts. So, all this money is at a stake and under huge risks. Important to mention, that undoubtedly without

proper projections success cannot be guaranteed and risks cannot be estimated. Hence, it is crucial to make projections of future product performance in advance before a launch.

For sure, there might be not only new products, but also product line extensions. As it was stated before they are quite similar to existing goods but still have differences in characteristics. Despite these similarities, it is still a new product which might not perform as good as its predecessor, so in any case projections are needed to be sure that this launch will be successfully perceived by a market.

Currently there are numerous approaches how to evaluate sales and demand for a new product launch, which are described below.

1.5. Types of new product forecasting

Nowadays there are numerous approaches how to forecast future success of a new product. All of them use different data and engage different stakeholders. From the perspective of data analyzed as well as the output obtained it is reasonable to classify all the methods into two types: judgmental, quantitative, causal, market analysis and other approaches (Kahn, 2010). Both groups are discussed below.

1.5.1. Judgmental methods

Judgmental methods are mainly based on subjective opinions and judgements of stakeholders of a company: customers, employees, suppliers, etc. These types of tools are used for long-term decision-making. All subjective methods can give unique insights in product launch aspects, but usually they are rather time-consuming and expensive. This group of models comprises following models:

Delphi method

Delphi method is made to structure communication of a group to make communication effective to solve complex issues. This method is a forecasting technique which mainly relies on experts' panel opinions. The whole panel is given a questionnaire, which experts answer within two and more rounds. At the end of each round a special person, a facilitator, makes an anonymous summary of experts' answers including their forecasts and justifications. Afterwards, experts may change their opinion regarding answers of other panel members. Thanks to such a procedure, it is assumed that the range of forecasts is reduced and, at some point, the general forecast will converge to a consensus or in other words "correct projection" of a new product launch. The whole questionnaire process ends after a predefined criterion and then average is calculated, showing the final opinion of the panel.

This method has several advantages (Lazăr, et al., 2004):

1. Use of wide expertise;
2. Possibility to get consensus quickly;
3. Since the process is anonymous, there is absence of halo effect, when participants are affected by a more dominant one;
4. Participants can participate in a questionnaire from any place;
5. No time pressure on participants in a process.

Unfortunately, this approach has several limitations (Lazăr, et al., 2004).

1. Difficult to engage high quality experts;
2. Results can be biased by a facilitator;
3. Quality of research depends on quality of experts.

Jury of executive opinion

This method is based on viewpoints of company's managers concerning the forecast of new product launch. Usually this group of people consists of interested managers, who can add information and expertise to the issue. Normally, these employees represent all six functional areas: finance, marketing, sales, operations, manufacturing, procurement, accounting. All members of the meeting discuss and add up their own opinion and justifications with respect to their background and knowledge. All the judgements are supported by relevant information about economics, politics, market, market players and their actions and competitive responses, relevant news from customers or distributors. So, this approach can be perceived as a top-down.

This approach undoubtedly has numerous advantages (University of Delhi, 2016):

1. Not capital-intensive and not time-consuming;
2. Provides flexibility and relevant for quick environmental changes;
3. Provision on holistic data from all functional divisions;
4. Personal expertise and knowledge of jury members;

Along with the list of benefits this approach also has several drawbacks (University of Delhi, 2016):

1. Not supported by statistical tools;
2. Group thinking;
3. Possible incorrectness of forecasts due to remoteness from the market;
4. Possible negative influence from interpersonal conflicts and presence of people from different management levels.

This approach is proved to be one of the most popular ones among companies. In the paper of Singh (2006), the author surveyed 168 companies regarding methods used for

forecasting. Around 44% of respondents used the method of jury of executive opinion for forecasting, which is second result (Singh, 2006).

Sales force composite

This approach stands for a special forecast tool when sales employees project sales results for their region or territory. Afterwards all the forecasts are consolidated at different level like branch, region, area and then the overall consolidated results are summed to get overall company's forecasted result of sales. This tool is opposite to jury of executive opinion and is mainly bottom-up. This approach is widely-used since sales personnel works closely with clients and markets and understand current trends and changes.

Considering the advantages of this approach, they are as follows (Business Jargons, 2016):

1. Sales personnel has specific knowledge and expertise of current market trends as well as specific market characteristics that might be important for forecasting;
2. There is a clear correlation between forecasts and necessity to achieve forecasted results;
3. More people participate in forecasting as well as all data is already segmented by time and geographical areas, hence this method is more reliable.

Along with the list of benefits this approach also has several drawbacks (Business Jargons, 2016):

1. Sales personnel might not have specific expertise in forecasting, hence they might not be able to use complex methods, leading to misleading results;
2. Sales personnel might not have enough information for forecasting due to working in a specific region;
3. Sales personnel might produce misleading results due to working in specific regions meaning not having full picture of industry conditions;
4. Sales personnel while working in specific regions might be influenced by this particular market conditions, hence producing misleading results;
5. Sales personnel might underestimate future sales results in order to be surely able to fulfill them and get higher annual performance bonuses.

This approach also is proved to be one of the most popular ones among companies. In the paper of Singh (2006) it was said that around 39% of respondents used this method which is third result (Singh, 2006).

Assumption-based modeling

This approach is used to project future market environment through segmentation of market drivers. A forecaster assumes values for all market drivers and generates projections. For market drivers' segmentation researchers may use ATAR model, which helps to forecast sales volumes of a company. Specifically, this model is useful to model financial results of both consumer packaged products and new products, marketing campaign or other projects.

The abbreviation ATAR stands for:

- A = Awareness
- T = Trial
- A = Availability
- R = Repeat purchase

Below there is an example of how ATAR model is used and how forecasts are done.

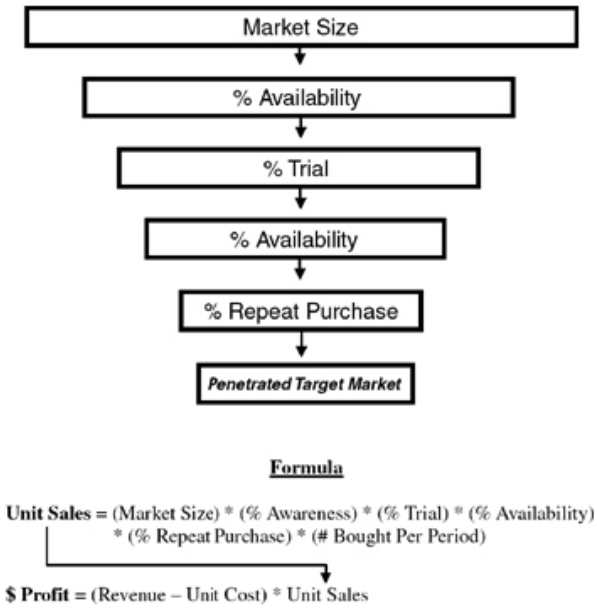


Figure 1. Assumption-based modeling: ATAR model (Kahn, 2010)

Considering the advantages of this approach, they are as follows (Fripp, 2016):

1. Alignment of financial and marketing factors;
2. Detailed analysis of data;
3. Flexible in goals' achievement;
4. Flexible regarding industries and markets.

Along with the list of benefits this approach also has several drawbacks (Fripp, 2016):

1. Highly sensitive to input data;
2. Highly sensitive to assumptions;
3. Works better not for all strategies, but for line extension and product improvement;
4. Possibility of overinflated projections due to high wrong assumptions and data.

Scenario analysis

This approach assumes that the process of forecasting starts with development of possible outcomes (scenarios). The researcher states important assumptions for projections. For each group of assumptions, a forecaster develops possible outcomes, for each of which he or she states and charts possible future scenarios. Based on these scenarios a forecaster decides which of them is most likely for company's development.

Scenario planning can be segmented into two types: exploratory and normative. The former type assumes that future scenarios are based on the analysis of the present and consideration of current trends. Normative analysis is an opposite type and assumes that at first the future is forecasted and then actions, needed to achieve this future plan, are determined.

Advantages of this approach are (Mietzner, et al., 2004):

1. Overview of project' riskiness;
2. Determination of inputs that influence the value;
3. Opportunity to capture weak signals and include them in a long-term planning;
4. Large number of different scenarios approaches makes forecasting more flexible.

Disadvantages of scenario approach are (Mietzner, et al., 2004):

1. Time-consuming approach;
2. Necessity of in-depth knowledge and expertise in an analyzed field;
3. Difficult not to focus on extreme or highly possible outcomes.

1.5.2. Quantitative methods

Quantitative methods in comparison to qualitative ones are based on historical data. All projections are done mathematically with the use of mathematical tools. According to a work done by Kahn et. al (2005), authors segmented approaches in quantitative, causal, market analysis and other approaches. This way of classification is used below to overview recent forecasting tools.

Trend line analysis

This first tool of forecasting is a very simple one. Previous historical data is collected and analyzed on a subject of an existing trend either downward or downward. The trend can be derived either graphically or mathematically. Based on a trend, future results are forecasted. This method has several advantages: it is easy to use, does not require a lot of time and efforts. However, this tool has numerous drawbacks. Firstly, results are not reliable, since a trend shows a general way of development with no precise dynamics. Secondly, sometimes it is difficult to figure out a trend in a data set, which means that this approach will not give any forecast.

Smoothing techniques

Smoothing techniques are quite popular way to forecast data. This approach assumes smoothing a data set to remove a noise (a random variation), which may influence final results. This approach is mainly used to use average – either moving average or exponential smoothing. Both tools are described below.

Moving average. This approach is also based on use of historical data. It helps to derive general trend from data of past periods. It is called average since it is an arithmetic average of past demand/sales for n available observations. It is called moving average, since a new value of demand/sales is added to the data set, while the last observation is dropped out from the sample. For a one-step forecast one can use the following equation:

$$F_t = (\frac{1}{N})\,(D_{t-1} + D_{t-2} + \ldots + D_{t-n}) \quad (1)$$

where:

F_t – forecast of a period t

N – number of observations

D_t – historical observation of a period t

This technique is useful for short-term forecasts. Apart from that, it is easy to understand and calculate as well as it can give stable forecasts. However, still this approach requires relatively big sample, has lags behind a trend due to the moving aspect and does not consider complex correlations in data.

Exponential smoothing techniques. This is another tool how to forecast using a principle of data smoothing. The logic applied here is a bit different. In order to use exponential smoothing one needs to collect historical data and to assign a smoothing factor or a constant, which is applied to most recent observations (Piasecki, 2012).

$$F_{t+1} = (D_t * S) + (F_t * (1 - S)) \quad (2)$$

where:

F_{t+1} – forecast of a period t+1

F_t – forecast of a period t

D_t – historical observation of a period t

S – smoothing factor

This approach proved to be one of one of the easiest way to forecast data. So, main advantages are easiness to use and calculate on computers, no need to agree on number of observations analyzed (how it is in moving average). However, comparing to moving average it is not that flexible in calculations, no rule for smoothing factor choice.

Looks-like analysis (analogous forecasting)

Analogous forecasting became one of the most widely-used tools regarding sales projection. This tool is used to forecast sales of a product based on historical data of previous product launches. In order to use this tool in general it is needed to find similar product, which was launched recently, collect monthly or weekly data, assign a percent of total sales as a guidance for trajectory and forecast expected sales of a new item.

Vital to point out that there are different types of this approach. The first type is based on consideration of product life-cycle and projections based on these dynamics. The second type takes into consideration several different launches segmented by various features.

Product life-cycle analogy. This method is a useful tool in case if a company wants to launch a product not significantly different from existing ones. Here a company uses available information about life cycles of already existing product or services. This means can provide with a good information especially if a company produces or/and sells widely purchased goods. Here an assumption lies that innovations are not a significant break-through in technological or consumptive aspects. Gartner et al. (1993) pointed out that this tool is good to use with other means in order to increase the accuracy of sales predictions.

Structured analogy. Another type of looks-like analysis is a structured analogy. It is a well-organized procedure to forecast sales in a formal way based on a set of similar goods launches. This approach is done in this way on order to make the projection process easier for experts and make projections more accurate.

There are several steps to be done (Green, et al., 2007):

1. Target situation description

Here a responsible person prepares a brief description of a current situation, in this case product launch. If it is possible, description of possible situation outcomes may be presented in a document.

2. Analogies identification and description

A responsible person invites several experts who will be in charge of analogies choice. These exerts must possess relevant knowledge and experience of similar situations. Their main task is to have to find out possible similar situations and describe them regarding: product type, launch season, price, targeted customer groups, physical characteristics.

3. Similarity analysis

Experts are to analyze similarities and differences between a company's new product and analogies and rate these results.

4. Projections

To project future sales one should use pre-defined rules and use analysis done by experts.

Diffusion models

Diffusion models are aimed at estimation of sales growth rate though consideration of different factors, which influence product adoption process. Among these factors one considers such points as mass media and word of mouth influence on end consumers. Consumers are segmented in the following way: *lead users, early adopter, early majority, late majority, and laggard customer segments* (Kahn, 2010). It is important to mention that there are a lot of diffusion models. Among them are Bass Diffusion model, Logistic model, Gompertz Curve model.

Bass Diffusion model is one of the most famous ones. The core assumption of this model is that the popularity and adoption of a product by consumers is driven by word of mouth. In terms of consumers, the model implies two groups of consumers: innovators and imitators. Once a new product is launched on the market, the first groups of people, who will buy is, are innovators. In case if they are satisfied with a good or service, then they may influence consumer behavior of other people on the market, who might become potential purchasers. These type of consumers is called imitators. The author of this model F.M. Bass stated the idea: "The probability of adopting by those who have not yet adopted is a linear function of those who had previously adopted" (Bass's Basement Research Institute, 2010). In mathematical terms this idea can be described with the following equation (Bass's Basement Research Institute, 2010):

$$\frac{f(t)}{1-F(t)} = p + \frac{q}{M}A(t), \quad (3)$$

where:

M – potential market;

p – innovation coefficient (retrieved from historical data);

q – imitation coefficient (retrieved from historical data);

A(t) – adoption function.

Real options

One of modern ways how to assess future results of a new product launch is real option analysis (ROA). In order to understand principles of this approach it is necessary to introduce notions of financial and real options. An option stands for the right, but not the obligation, given to an owner, to purchase the underlying asset in the future for a price, which is fixed today (Brach, 2003). Options might be distinguished by decision of selling or buying (call and put) and time of making decisions (European and American).

As for a real option, it is an opportunity to take a certain business decision in the future. Additionally, a real option should consider two important aspect. Firstly, it should be designed from the beginning of a project and be irreversible. Secondly, an investment decision should be uncertain in the future so to give a possibility for an optimal outcome via real option analysis for each possible state (Bukhvalov, 2016). This tool is used for both valuation and in-depth analysis (Brach, 2003).

Comparing financial and real options, they are similar in ways how to evaluate a value as well both can be call and put, European and American. However, whereas financial option has a financial instrument as an underlying asset, real options deal with real assets and financial decisions. Additionally, real options additionally can be classified by types of business alternatives (Trigeorgis, 1996):

1. To defer – a company has an opportunity to postpone an implementation of a business decision till better time
2. Time-to-build option – any business decision might be viewed as a set of stages, each of which can be perceived as an option, so the whole time-to-build option is compound.
3. To expand – if the future market situation is favorable, hence a company can expand its operating capacity or increase a resource utilization.
4. To abandon – if market situation is projected to worsen, a company has an opportunity to cancel out the whole project and resell all the equipment on a secondary market.
5. To switch – if demand or supply is about to change, a company has a possibility to change a production mix.
6. Growth option – any investment can be viewed as a starting point for growth of other interrelated projects in the future, so this option can be perceived as an interproject compound one.
7. Multiple interacting options – many projects might include several real options; important to say that the sum of options' values may not equal to their combined one.

The valuation of real options can be done via a decision tree or Black-Scholes model depending on a type and a business decision.

Speaking about benefits and drawbacks, ROA undoubtedly gives more flexibility in valuation of business decisions, including several future states. However, it heavily relies on defined assumption and data inputs, which can significantly influence on final results.

1.5.3. Causal modeling

Regression modeling is a mathematical approach to forecast demand or sales for a new product. It assumes development of a mathematical model in order to establish relation between data. Technically, researchers, who develop these models, try to establish a relation between

dependent variable, which is an observing factor, and independent variables. This is done through estimation of a regression equation, which afterwards can be used for further forecasts.

This type of tools can be classified into different types.

Linear regression. This type of regression assumes that the relation between an observable factor and independent variables is strictly linear. This relation is derived from collected historical data.

Non-linear regression. Non-linear regression assumes that the relation between dependent and independent variables might be non-linear.

Logistic regression. Logistic regression is a probabilistic approach to forecasts. Technically, a researcher finds the relation between independent variables and binary outcomes, collected from previous observations. For instance, in a case of product line extension, it might be outcomes "purchase" and "no purchase". Final output of this model is to estimate a probability that this or that binary outcome will happen.

This approach proved to be efficient. This is achieved thanks to extensive choice of data and explanatory variables if it is possible. However, this approach can lead to difficulties with data collection, variables justification, estimation issues, connected with basic assumptions of linear regression, which are used both in linear and logistic regressions. Additionally, in a paper "Forecasting Methods and Applications" authors mentioned that time-series approaches (trend forecasting, smoothing techniques) are more precise in short term period of forecasting (Makridakis, et al., 1998). As for causal modelling, it was said that these models can provide with broader knowledge of factors and relations between variables.

1.5.4. Market and consumer research

This approach is related to research of the market and consumers' behavior and preferences. This is important especially when a company introduces a new product, since a new good can be perceived differently than existing ones. Talking about product line extension, a company issues a product, which is quite similar to existing ones, however has different features. Without this type of research, it becomes difficult to estimate possible reaction of consumers on it. With respect to this there several types of market and consumer research, which help a forecaster to project future results of a product launch.

Here a researcher gets a chance to understand attractiveness of a product for clients. Thanks to this approach a forecaster forms a focus group. Through surveys one can get information about consumers: gender, age, geographical distribution, need for a product or service, most likely price range adequate for consumers. Results of surveys are collected and statistically assessed in order to avoid bias and make it more reliable.

Business Intelligence. This type of research implies working with sales personnel. They are employees who work directly with markets and customers, hence they know peculiarities and important specifics. Working with consumers and sales specialists can give valuable insights and knowledge, important for forecasting. This information is analyzed and used for product development and further goods distribution.

Test Marketing. When a new product is about to be launched on the market, it is vital to know possible consumers' response on products. In order to do this a company starts to sell small amounts of goods to consumers on different geographical markets. This allows to capture information about demand and consumer behavior. The obtained information is analyzed on the subject of customer segments and consumption dynamics. Based on information gained from this market tests, a company decides whether to start a full-sized production, continue product development or just quit this option.

Previous Sales Data. If a company works for some time on the market, it is highly possible that it will have sales statistics of goods sales. This historical data is crucial and can be used in different analyses. On the one hand, one can derive a subjective opinion based on the collected data, which can be used in forecasting. On the other hand, one can use various statistical methods in order to get more quantitative insights for further projections of sales.

Leading Indicators. Leading indicators approach implies use of business and economic parameters in order to derive current market trends. These indicators might help to understand the dynamics of an industry: whether it grows, stagnates or declines. It is important to point out that these indices show only market dynamics and are not related directly to possible success of a product or service. This type of information can be perceived as supplementary one and helps to understand market state. This type of research might be useful for well-established organizations, since their sales trends are already established and might correlate with the whole market. Hence, companies can use this information for sales projections and market growth.

Benefits of this approach are:

1. Collection of primary data on consumers' reactions;
2. High level of expertise and knowledge;
3. In-depth understanding of market state and opportunities.

Drawbacks of this approach are:

1. Time and capital consuming approach;
2. High pace of trend changes;
3. No quantitative justifications.

1.5.5. Other quantitative tools

It is worth to mention that the list of tools, which form a pool of quantitative approaches, is not finite and recently the number of tools available increases. Currently other means are used to forecast future results of product launch such as expert systems, neural networks, simulation, etc. They are mainly a mixture between time series and regression models. These models are indeed complex to implement and still they have not captured wide attention of researchers.

1.6. Summary of Chapter 1

Chapter 1 was devoted to overview of widely-used marketing strategies and their efficiency evaluation.

Nowadays, marketing strategies are in wide use due to significant changes in technological and consumption spheres. On one side, due to technological breakthroughs and Internet development it becomes more difficult for companies to satisfy consumers' needs, since there is almost perfect information transparency and availability. Companies lose their power over consumers as well as their loyalty, because now people can shop online, find any products they like as well as compare them between each other. Hence, companies are forced to use various marketing strategies to attract consumers and keep them loyal to the brand. The most widely-used strategy nowadays is brand extension strategy, in particular product line extension strategy. It refers to the idea that a company issues new products under the same brand but with slight changes comparing to the core product. It requires relatively low investments and not that risky comparing to new product introduction. Major examples of successful strategy implementation are Coca Cola (Vanilla and Diet Coke), Apple (iPhone 5se), Samsung (A-series) and many other examples of FMCG and IT sectors.

It is important for a company to prove that the chosen product line extension strategy is successful. Currently, there are several types of tools used in order to evaluate results of the strategy. They are split into judgmental and quantitative methods, causal modelling, marker and consumer research and other more complex tools. The most prevailing type of results assessment is judgmental, since it easier and cheaper to implement. However, the lack of attention to quantitative tools is perceived as a gap for further research.

Chapter 2. Methodology and companies' choice justification

2.1. Methodology choice justification

Speaking about product line extension strategy and most common examples of its implementation, one can derive, that introduction of a new product, even with slight changes in characteristics, can be perceived as a typical investment project. As usual, it has its initial investments for product development and cash inflows, coming during the whole lifespan. The choice of tools for such a project analysis should reflect corresponding project's parameters. As it was said in Chapter 1, there are various tools that can be used in order to assess results of the strategy. They are judgmental and quantitative methods, causal modelling, marker and consumer research and other more complex tools. The prevailing part of tools used for the chosen strategy analysis and forecasting are subjective (judgmental) and are based on opinions of different stakeholders' groups. These means are easier to implement, does not require more technical knowledge and expertise. However, this type of means might not be highly reliable in case if the company works with high risks, costs and cash flows with incur in case of new product launch. Companies indeed have high level of uncertainties and necessity of having a freedom for decision making.

Comparing quantitative tools to qualitative they can provide with more in-depth analysis based on objective data. Among all quantitative means, Real Option Analysis (ROA) and Net Present Value (NPV) have gained high attention and popularity. The first tool gives flexibility in terms of decision-making process, which is crucial for companies: it can help to avoid unpleasant outcomes and damage to company's performance. NPV is a common tool of projects performance analysis, widely used as a separate measure as well as a part of ROA.

Net Present Value

One of the most widely-used tools for project's valuation is NPV. It shows the value of a project based on cash flow it might produce. In a paper of Dias et. al (2002), researchers introduce NPV with discounted cash flow approach as a means to evaluate the value of a brand extension. They emphasize that despite its commonality this approach can lead to several valuation difficulties as well as does not consider flexibility of decision making process, which is important in brand development (Dias, et al., 2002). Mun (2006) expressed the same idea about NPV, however added that NPV can show a base scenario project's valuation and serve as a base for further ROA.

Real Options Analysis

Another tool to be used in order to assess the value of product line extensions is ROA. It

is a quite modern tool used to evaluate value of any project in case if it is irreversible investment and bears uncertainty in decision making process. It is widely used for any project's types assessment if it corresponds to the stated requirements.

Speaking about brand extension strategies, it was discussed that it assumes introduction of a new product with slight changes to the basic product, which can be perceived as a new project. It also has irreversible investments in product development as well as uncertainties. Among them are demand dynamics, price for materials, staff salaries, cancellation rate, etc. Based on these characteristics it is reasonable to use ROA as a tool for the analysis.

The ROA use has been also proven in several articles. In the paper "Conceptualizing and measuring the monetary value of brand extensions: The case of motion pictures" the author discusses movie sequels within brand extension strategy (Hennig-Thurau, et al., 2009). Additionally, in a paper of Dias et. al (2002), researchers use ROA as a main tool for valuing returns on brand extension. The main reasons to use it are: brand extension can be perceived as a project with uncertainty and ROA gives more flexibility in decision making. In the paper "Methods of Brand Valuation: A case study on Alibaba.com", the author states that brand extension and expansion can be evaluated through ROA, since it gives more flexibility in decision-making as well as decreases uncertainty (Bulgarelli, 2015).

Based on these academic discussions it was decided to use this tool for further analysis of product line extension strategy.

2.2. Choice of companies

The researcher has already mentioned that a lot of companies use branding strategies nowadays. Over last 15-20 years, companies flooded markets with products and services in majority of segments and niches. The researcher has already mentioned Coca-with its original Coke versus Diet and Vanilla Coke, Colgate with its toothpastes, Apple with cheaper version of smartphones, new games made by Ubisoft, and many other examples.

All these cases are academic and widely discussed by researchers since they refer to fast moving consumer goods (FMCG), technologies and automotive industries, which can be easily observed on the market. However, not only these sectors use these strategies so extensively. For this research paper, it was decided to analyze an aviation industry, since aircrafts producers probably not that obviously, but still use product line extension in order to retain big corporate clients attached to the brand. Aircraft producers tend to manufacture new models of airplanes with slightly different characteristics and in different pricing segments.

For the analysis, the researcher considers market leaders of aviation production sector: Airbus SAS and Boeing. Both companies are core players on the market, being the main commercial aircraft suppliers for almost all airlines in the whole world. These two companies are

presented in the same segments: commercial aircrafts, defense (including military aircrafts and helicopters), space (satellites, components).

2.2.1. Aircraft industry

One of the most dynamic industries nowadays is aircraft production. Historically, technological breakthroughs, favorable economic conditions in terms of growing demand for air transport as well decreasing costs of manufacturing and maintenance make the whole market more attractive. Currently, according to estimations of Airbus and Boeing, around 22 thousand of aircrafts are in service, resulting in around $3 trillion of value. This number is forecasted to grow within next 20-30 years.

Market overview

The whole market targets two core industry parts: military and civil aircraft manufacturing.

Military segment stands for production of military aircrafts. This niche is quite closed and based on governmental orders. The largest military producers are Boeing (US), Airbus (France), Lockheed Martin (US), United Technologies Corporation (US) and General Dynamics Corporation (US). Military segment in terms of US market comprises around 30% of the whole market aircraft output (Statista, 2015). According to expectations, general military segment is about to decline especially in developed countries but might increase in such countries as Russia, China, and the Middle East. Based on these segment characteristics it was decided to focus on commercial aircrafts manufacturing.

From the perspective of civil aircraft manufacturing, it is a core part of the industry. For instance, in US civil aircraft manufacturing comprises approximately 70% of the annual output (Statista, 2015). Historically, the demand for air transportation has been growing steadily for the last 30 years. From 1981 till 2016 the travel demand grew 3.5 times: from almost 1 billion to 3.5 billion of passenger annually (Figure 2) (Deloitte, 2016). The revenue passengers kilometers[1] has reached the highest historical level of almost 7 trillion increasing by 4.7% annually for the last 10 years (Deloitte, 2016).

[1] Number of passengers paying multiplied by distance travelled

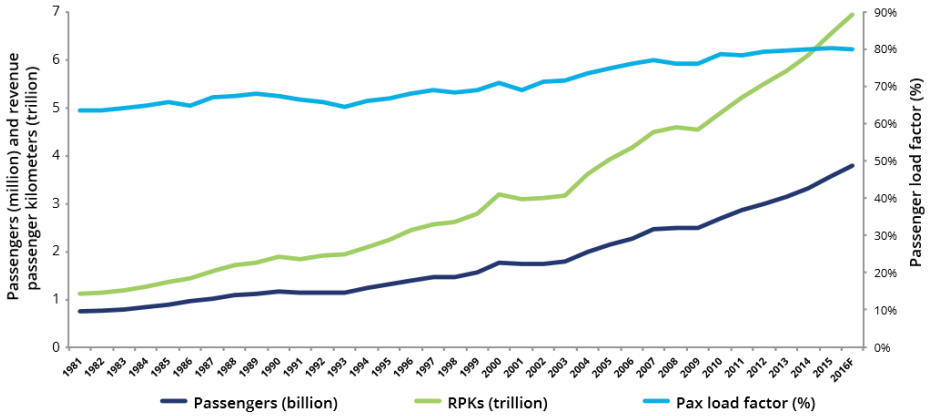


Figure 2. Passenger traffic (2010-2016) (Deloitte, 2016)

The core drivers for the demand growth do not end up with GDP growth, which indeed took place for the last 30 years. According to Airbus, among the reasons the researchers mentioned growing private spending, higher rate of urbanization, growing middle class, immigration simplifying procedures, tourism, airline business models with higher degree of liberalization (Airbus, 2016 c). All these factors are additionally accompanied by higher affordability of flights and lower costs of transportation.

Current market development and economic changes also help airlines to benefit. In 2014, the price for 1 barrel of oil was around $100 (Nasdaq, 2017). In 2016, the level of prices has declined dramatically till $40-50 per barrel making fuel costs more affordable for airlines, making their operations more profitable. Apart from that aircraft producers provide more cost-efficient models of airplanes in terms of maintenance and fuel consumption, leading to even more profitability for airlines. According to the analysis, airlines obtained about $35 billion profits (Boeing, 2016 c). All these factors could be drivers for the increased demand for aircrafts. The following graph shows a surge of orders in 2007 and 2014. For the upcoming years the level of orders might decrease.

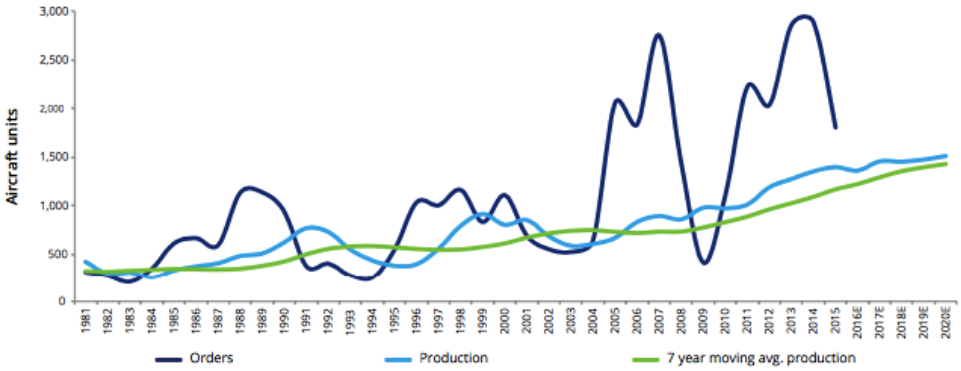


Figure 3. History and forecast for large commercial aircraft orders and production (Deloitte, 2016)

With respect to Airbus and Boeing forecasts, this market will continue to expand in terms of passengers and aircrafts produced. The passenger traffic for the next 20 years is about to double (Figure 4). The compound growth rate of the traffic for the next period is about 4.7% (Boeing, 2016 c). The overall need for new aircrafts will be approximately 33 thousand of new aircrafts both for passenger and freight fleets. The overall value of the developing opportunities is estimated to be $5.2 trillion for the next 20 years (Airbus, 2016 c).

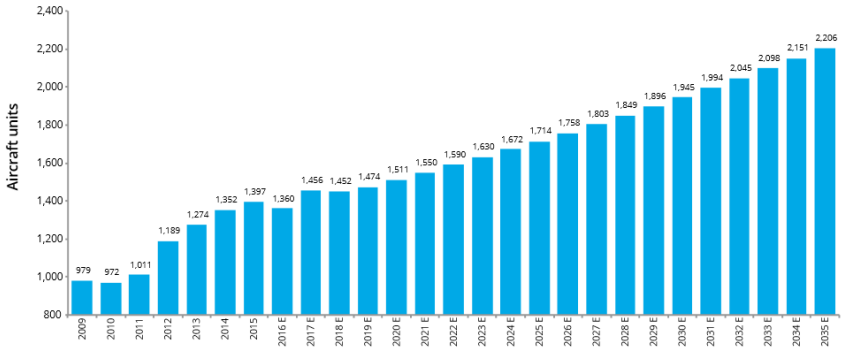


Figure 4. Aircraft production (2009-2035F) (Airbus, 2016 c)

Market structure

The market of civil aircrafts production could be described as a duopoly. Main players still are Airbus (France) and Boeing (US), covering almost 90% of the whole market (Tolkachev, 2011). These corporations have been dominating for almost 30 years. Even though recently Embraer (Brazil) and Bombardier (Canada) are gaining more market share, these companies targeted slightly different niches, separated with respect to flight distances and number of people transported.

5. Medium and long-haul wide-body. Basic fuselage is about 5-6 meters long; one row comprises 7-10 places. Usually, there are two aisles. Such type of an aircraft can carry 300-500 people. Famous representatives of wide-body aircrafts are Airbus A380, Boeing 747 and 767 (Tolkachev, 2011).
6. Medium and long-haul narrow-body. Basic diameter of fuselage is 4 meters. Such aircrafts are used for shorter range and they carry less people (~280 passengers). Famous representatives of narrow-body aircrafts are Airbus A320, Boeing 737, IL-62, TU-154 (Tolkachev, 2011).
7. Regional, short-haul aircraft. These aircrafts have smaller sizes, can carry less than 100 passengers for a flight with a range around 2-3 thousand of kilometers. Famous representatives of regional aircrafts are AN-24, YAK-40, Bombardier DHC-8, Embraer ERJ-145 (Tolkachev, 2011).

8. Commuterliners. Lower class of aircrafts made for approximately 20 passengers and the flight range of 1000 kilometers. Famous representatives of regional aircrafts are Cessna and Beechcraft (Tolkachev, 2011).

As it can be observed. Airbus and Boeing are mainly producers of wide-body medium and long-haul aircrafts, while their core competitors are not presented there and mainly manufacture smaller airplanes.

For further analysis we decided to focus on Airbus and Boeing for several reasons. Firstly, these two companies are long-term leaders of the market with long story of their competition. A lot of researchers published articles related to their price and orders rivalry. Secondly, currently two players introduced new projects which attracted a lot of attention since they are brand new in terms of production and compete directly against each other. Third reason refers to the question, that their competitive situation was covered not even once in academic literature, however there was no attention to their product rivalry and their product strategies.

2.2.2. Airbus

Airbus Group SE is a leading international company which was founded in 2000 as EADS (European Aeronautic Defense and Space Company). It was formed due to a merger of Aérospatiale-Matra, DaimlerChrysler Aerospace AG (DASA), and Construcciones Aeronáuticas SA (CASA). In 2014, the company was reorganized to Airbus Group which added divisions of development, civil and military aircrafts marketing, communication systems, missiles, space rockets, helicopters, satellites, and related systems. Currently, the whole corporation offers products and services related to commercial aircrafts, defense and space production (Airbus, 2017 e).

Headquarter is based in Leiden, the Netherlands. Regarding the segments, it has the following business divisions: Airbus SAS (commercial aircrafts), Airbus Defense and Space, and Airbus Helicopters (Airbus, 2017 e).

EADS employs more than 133 thousand of employees. The whole group presented strong financial results in 2016, resulting in EUR 66 billion. The turnover of the company on average has been growing with 7% rate for the last 5 years. Considering the last financial period, the growth rate of the revenue increased be 3%. Talking about earnings before interest, taxes (EBIT), it has been decreasing on average at -44% growth rate for the last 5 years. The result of 2016 is -44% lower than the prior year result (Airbus, 2017 a).

The 2016 financial results of the corporation regarding each of operating divisions is shown below (Airbus, 2017 a):

- 69% - Airbus SAS, commercial aircraft production;

- 21% - Airbus Defense and Space;
- 10% - Airbus Helicopters.

Airbus SAS comprises the major turnover part of the whole Airbus Group. What is more, this exact division has been actively introducing new models and versions of civil aircrafts. Based on these facts, it was decided to concentrate on this operating division.

Airbus SAS is a multinational commercial aircraft manufacturer, based on Blagnac, France. It is a division of Airbus Group SE which mainly specializes on space and defense goods production. The commercial part of Airbus Group has been founded in 1970 as a consortium of airspace manufacturers. During 2000 within a consolidation process a joint-stock company has been formed, and a commercial aircraft manufacturer Airbus SAS was created (Airbus, 2017 e).

Airbus is indeed an international corporation. Currently it has 16 core sites in France, Germany, Spain and the United Kingdom. The assembly of aircrafts is done in France, Germany, Spain, US, and China. Additionally, Airbus has subsidiaries in US, Japan and India (Airbus, 2017 e).

Currently, the commercial division employs 72 thousand of people. Considering its financial performance, this operating division has earned EUR 45 billion in 2016 as turnover and EUR 3 billion as an operating profit for the same period (Airbus, 2017 a).

Concerning its product portfolio, Airbus has been investing heavily in the differentiation of its product line. Historically, Airbus had 10 models with various characteristics: length, number of aisles, number of engines, maximum range of flight. In the following table, all models are described.

Table 2. Airbus aircrafts

Model	**Characteristics**	**# of seats**		**1st flight**	**Orders**	**Max range (km)**
		Min	**Max**			
A300	2 engines, twin aisle, single deck	228	361	1972*	561	7500
A310	2 engines, twin aisle, single deck	187	279	1982*	255	9540
A318	2 engines, single aisle, single deck	107	132	2002	80	7800
A319	2 engines, single aisle, single deck	124	156	1995	1481	11100
A320	2 engines, single aisle, single deck	150	180	1987	13075	7800
A321	2 engines, single aisle, single deck	185	236	1993	1736	5950
A330	2 engines, twin aisle, single deck	246	440	1992*	1682	13450
A340	4 engines, twin aisle, single deck	239	440	1991	377	16700

Cont. of table 2

A350	2 engines, twin aisle, single deck	270	550	2013	820	18000
A380	2 engines, twin aisle, double deck	270	550	2013	317	15200

* - discontinued

Source: Airbus website (Airbus, 2017 b)

For the whole history of Airbus SAS, it received 17 thousand of orders for different models and fuselage types. It has delivered 10 thousand of aircrafts, having around 7 thousand in backlog (in production) (Airbus, 2017 d).

2.2.3. Boeing

The Boeing Company is the second largest international air transport producer in the world originally from US. It was founded in 1916 as a company called “Pacific Aero Products Co." in Delaware. The whole company has passed through lots of changes and events. Only in 1917 it got a famous name "Boeing Airplane Company". Currently, the whole corporation offers products and services related to aircrafts, rotorcrafts, rockets and satellites (Boeing, 2014 b).

It has headquarters in Chicago, Illinois. The whole corporation comprises the following divisions: Boeing Commercial Airplanes, Boeing Defense, Space & Security. Three other parts of the company (Engineering, Operations & Technology, Boeing Capital, Boeing Shared Services Group) refer to complimentary businesses (Boeing, 2017 d).

The Boeing Company employs more than 157 thousand of people. The whole group presented strong financial results in 2016, resulting in USD 94.6 billion. The turnover of the company on average has been growing with 5% rate for the last 5 years. Considering the last financial period, the growth rate of the revenue declined to -2%. Talking about earnings before interest, taxes (EBIT), it has been increasing on average at 23% growth rate for the last 5 years. The result of 2016 is 22% lower than the prior year result (Boeing, 2017 d).

The whole group presented strong financial results in 2016, resulting in USD 94.6 billion. The financial contribution of each of operating divisions is shown below (Boeing, 2017 d):

- 68.8% - Boeing Commercial Airplanes (BCA);
- 31% - Boeing Defense, Space & Security;
- 13% - Boeing Military Aircrafts;
- 10% - Global Services & Support;
- 7% - Network & Space Systems;
- 0.3% - Boeing Capital.

BCA comprises the major turnover part of the whole Boeing Group. What is more, this exact division has been actively introducing new models and versions of civil aircrafts. Based on

these facts, it was decided to concentrate on this operating division.

Concerning its product portfolio, Airbus has been investing heavily in the differentiation of its product line. Historically, Airbus had 10 models with various characteristics and variations: length, number of aisles, number of engines, maximum range of flight. In the following table, all models are described (Boeing, 2017 a).

Table 3. Boeing aircrafts models

Model	Characteristics	# of seats		1st flight	Orders	Max range (km)
		Min	Max			
707	4 engines, single aisle, single deck	140	219	1957*	865	10650
717	2 engines, single aisle, single deck	100	134	1998*	155	3815
720	2 engines, single aisle, single deck	140	170	1959*	154	6820
727	3 engines, single aisle, single deck	149	189	1963*	1831	5000
737 Original	2 engines, single aisle, single deck	85	215	1967*	1144	4800
737 Classic	2 engines, single aisle, single deck	149	179	1984*	1988	4398
737 NG	2 engines, single aisle, single deck	110	210	1997	7049	5991
737 MAX	2 engines, single aisle, single deck	150	230	2016	3606	7084
747	4 engines, double aisle, double deck	440	660	1969	1418	13450
747-8	2 engines, single aisle, single deck	410	650	2008	138	14320
757	2 engines, single aisle, single deck	200	295	1981*	1049	7590
767	2 engines, double aisle, single deck	181	375	1981	1189	11825
777	2 engines, single aisle, single deck	314	396	1994	1596	15844
777X	2 engines, single aisle, single deck	355	409	2020	306	16100
787	2 engines, single aisle, single deck	242	335	2009	1200	14140

* - discontinued

Source: Boeing website (Boeing, 2017 a)

For the whole history of BCA, it received 23.6 thousand of orders for different models and fuselage types. It has delivered 17.9 thousand of aircrafts, having around 5.7 thousand in backlog (in production) (Boeing, 2017 f).

2.2.4. Airbus and Boeing competition

It can be said that the competitive situation of civil aircraft production have been stable for quite a long time. French Airbus and American Boeing have occupied the market with their

innovative products since late 1990-s, making it duopolistic. This situation occurred due to a number of mergers and acquisitions done by both companies.

In 1997 Boeing acquired McDonnell Douglas, the main competitor on the market of civil aircrafts. In 1996 McDonnell Douglas was left with no funding for further civil sector development. The market of civil aircrafts was already highly competitive and dominated by Boeing, with whom it was tough to compete. Additionally, the company was excluded from the governmental development project of a jet fighter, which was a big failure. Thus, the management of the company started negotiations with Boeing, and in 1997 the merger deal has been completed. This deal helped Boeing to get stronger position on the market of civil aircraft production (Boeing, 2014 b).

As for Airbus, it was created as a consortium in 1999: consolidation of aerospace and defense companies. The new corporation is solely owned by European Aeronautic Defense and Space Company (Airbus, 2017 e).

The whole intense competitive situation started with two core Airbus decisions: to sell aircrafts with negative profit and invest heavily in A380. This step helped Airbus to gain bigger presence: the corporation outperformed Boeing in 2011 in terms of sales: 534 versus 477. Since then the leading position during last years is almost taken by Airbus. Thought Boeing tries to outperform the rival, leading to a very aggressive competition. At first, companies accuse each other for using state aids and governmental orders. For instance, in 2015 Boeing started litigation with Airbus regarding the latter to apply for state loans to finance its revamped A380 Jumbo (largest aircraft) (Hotten, 2015). Boeing claimed that the application for state loans would breach World Trade Organization's (WTO) rules. Airbus decided not to stay aside that in return accused Boeing for using benefits from tax breaks, which it can use in Washington district. Such kinds of argues and accuses occur between both competitors regarding possible governmental aids and orders (Hotten, 2015).

Second aspect of their competition is product portfolios. Both corporations operate in the niche of wide-body aircraft production. Since the start of the intense market actions, both companies try to issue more or less similar models. Even being a bit different, Airbus A330neo is a relative close substitute to Boeing 787; Airbus A350-900 seems to be similar to Boeing 777X-8. The same works for largest wide-body long-haul aircrafts such as A380 and 747.

Table 4. Airbus and Boeing aircrafts comparison

Model	Length	Weight (tons)	Passengers max	Max range (km)	Price
Single aisle					
A320neo	37.57 m	79 t	165	6500	$107.3 M
737MAX-8	39.5 m	82 t	162	6510	$110.0 M
Double aisle					
A330neo-800	58.82 m	242 t	257	13900	$252.3M
787-8	56.69 m	228 t	242	13620	$224.6M
Double deck					
A380	72.72 m	575 t	544	15200	$428 M
747-8	76.3 m	448 t	410	14320	$378 M

Source: Airbus (Airbus, 2017 b) and Boeing (Boeing, 2017 a)

Additionally, both companies try to issue new models and updated versions of existing ones. Airbus introduced A320neo as an update for existing A320 with new engines (neo – "New Engines Option"). Airbus claimed that this model consumed less fuel per seat. The same is done by Boeing. It introduced 737MAX-8. Historically, this model is a forth variation of 737 family. It was targeted to outperform Airbus aircraft in terms of fuel and overall operating efficiency. These examples are not only ones. The table sums up several examples in terms of length, range, prices and weight in order to compare the competitive reaction.

In overall one can conclude that companies are competing against each other in terms of issuing new variations of aircrafts with slight differences in design, engines, and prices. From the perspective of marketing theory, these companies are following the strategy of product line extension. It is said that product line extension is when a company uses its existing brand to introduce a new product, which has slightly different characteristics, in already existing product segment. Hence, one can derive that:

- All new products of Airbus and Boeing are within the same product segment;
- All new products are produced under the same brand;
- All new products have slightly different characteristics comparing to their predecessors.

Taking into consideration, that both companies introduce new model and modifications relatively frequently, it is important to understand whether this strategy gives a value to both companies and which company is more successful in terms of product line extension strategy implementation. For the analysis the researcher has identified two projects which correspond to the chosen strategy. These investment projects are Airbus A350XWB and Boeing 777X. Both aircrafts families are new models which are introduced soon to the market and again compete

directly against each other.

2.2.5. Chosen projects: Airbus A350 XWB and Boeing 777X

For this paper, it was decided to analyze two newcoming models of aircrafts: Airbus A350XWB and Boeing 777X. They have been chosen by several reasons. Speaking from the side of companies, firstly, these two companies are direct competitors, which have been playing against each other since late 1990-s. Secondly, both companies are core players of the market: they have the same scale of operations in the same niches, their market values are comparable. From the side of products, as it is stated by companies, both aircraft models compete directly against each other. Additionally, they are relatively new projects, which have high uncertainty level of their future success. Below both projects are described and compared to each other.

Airbus

As for the case for this paper, the researcher decided to analyze A350 XWB aircraft model line. This family is a group of civil aircrafts with Extra Wide Bode (XWB), long-range, twin-engine airplanes. A350 XWB family was discussed first time in 2004 as an idea to compliment A330 but with better engines and fuselage: the body should have been done from an innovative carbon-fiber-reinforced polymer, whose proportion in a whole material volume comprised 50%. As an aircraft model, it was aimed to replace its outdated version A340. As for the market response, A350 was targeted to compete with Boeing 787 and 777. The whole development of A350 XWB family was estimated at EUR 11 billion (Airbus, 2017 b). The project comprised several variations of the aircraft.

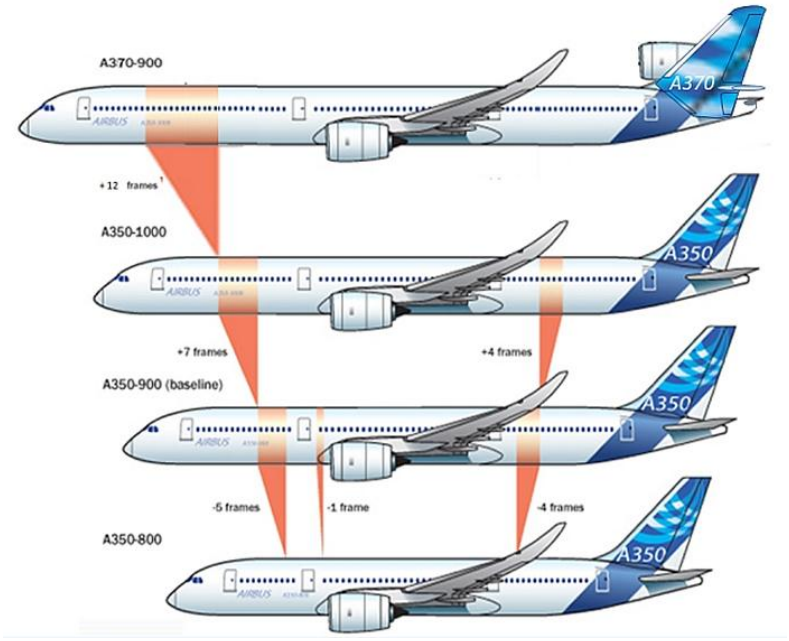


Figure 5. Comparison of Airbus aircrafts (Aviation Explorer, 2017)

A350-900. This airplane was designed to have 325 seats with a flight range of 15000 kilometers. The length of the aircraft is 66.8 meters. Airbus claimed that this model would be 25% lower as for cash operating costs, 30% less as for the block fuel consumption, and 16% lighter comparing to its direct competitor Boeing 777-200ER. This A350 representative is a direct competitor to Boeing 777-8 and 787 as well as successor of A340-300 and A340-500 (Airbus, 2017 b).

A350-1000. This model is the largest one for family. 1000 version was created with 73.8 meters length, 366 seats within 3 classes and 9-abreast configuration. The expected flight range is 14800 kilometers. This model is lighter than its competitor Boeing 777-9, has 15% less costs per seat. Comparing to its direct competitor Boeing 777-300ER it has 25% less fuel consumption costs (Airbus, 2017 b).

Additionally to these models there was a smaller version A350-8. This representative of A350 family was expected to have 280 seats within 3 classes and a 9-abreast seating. The length of the body was designed to be 60.5 meters. The projected range of flight was designed to be 15200 kilometers. This particular model was a shorter version of A350-900. Having 182 orders in backlog Airbus decided to cease the production of this aircraft ad change orders to A350-900 version (Airbus, 2017 b).

Currently, Airbus has received 820 orders from 46 clients for the whole family. Among large customers one can point out Singapore Airlines, Etihad Airways, Lufthansa, Virgin Atlantic, etc. (Airbus, 2017 b).

Boeing

As a counter case to Airbus A350 the researcher decided to take Boeing 777X family. This model of aircrafts has been created as a competitive response to Airbus new aircraft family launch. This project was initially discussed in 2011 as a replacement to older model 777-200ER and 777-300ER, which were introduced to the market in 1994. The new version was expected to have better engines as well as fuselage: the body should have been done from an innovative carbon-fiber-reinforced polymer, whose proportion in a whole material volume comprised 50%. The project is still not launched into production: larger version will be first time delivered in 2020, the smaller version in 2022, but previously these deadlines were postponed from 2018. The initial investment for model development is USD 11.8 billion (Boeing, 2017 a). The project comprised several variations of the aircraft.

Figure 6. Comparison of Boeing aircrafts

777-8. This model of an aircraft is a successor of Boeing 777-200 (versions ER – "Extended Range" and LR – "Longer range") and 777-300. In terms of length, it is expected to be 69.8 meters, between lengths of both predecessors. Considering passengers, there will be 350-375 seats. The expected range of the flight is 16 thousand of kilometers. Comparing to Boeing 777-300ER, this version is expected to be 13% more fuel efficient since it has less seats. This is a direct competitor to Airbus A350-900 (Boeing, 2017 a).

777-9. This representative of 777X family is the largest one. It will be a longer version of Boeing 777-300ER by 3 meters and the total length will be 76.7 meters. This aircraft will be able to transport from 400 up to 425 passengers. The total range of a flight is 14 thousand of kilometers, 2 thousand less than the smaller 777-8 version. In terms of improvements, comparing to 777-300ER this model is forecasted to provide better fuel consumption efficiency by 13%. This is a direct competitor to Airbus A350-1000 (Boeing, 2017 a).

Currently, Boing has received 306 orders from 7 clients for the whole family. Among large customers one can point out Singapore Airlines, Etihad Airways, Lufthansa, Qatar Airways, etc. (Boeing, 2017 a).

Comparison

In order to sum up the overview of the aircrafts taken as a case for further analysis the researcher provides a comparison of technical characteristics. As it was stated, both projects compete against each other directly in terms of clients and niche. However, they provide different improvements as well as technical characteristics. From the table below one can derive

that models of Boeing are slightly longer and heavier comparing to Airbus as well as more expensive.

Table 5. Airbus and Boeing aircrafts comparison

Model	Length (meters)	Weight (tons)	Passengers (max)	Max range (km)	Price
Length < 70 meters					
A350-900	66.8	145	325	15000	$311 M
777-8	69.5	TBA	375	16000	$359 M
Length > 70 meters					
A350-1000	73.8	155	366	14800	$428 M
777-9	76.3	181	398	14000	$400 M

Source: Airbus (Airbus, 2017 b) and Boeing (Boeing, 2017 a)

We can sum up that both projects target the same niche, quite close in terms of technical characteristics and pricing.

2.3. Summary of Chapter 2

Chapter 2 was devoted to justification of tools used as well as industry, companies and their projects considered in the further analysis.

Among all tools currently discussed in Chapter 1 it was decided to choose Net Present Value tool (NPV) and Real Option Analysis (ROA). We discussed that brand extension strategies can be viewed as a basic investment project, since it also has initial investments, which are spent on new product development, cash flows and lots of uncertainties, which relate to such issues as demand, labor and production costs, currency exchange rates, and so on. Based on this logic we assume it reasonable to use NPV since it gives a basic scenario of the project as well as serves as a base for further analysis. As for ROA it proved to be poplar nowadays in times of high instabilities and uncertainties. Referring to several articles, which also consider brand strategies as projects with number of uncertainties it was proved that ROA is a suitable tool to be used in considered projects of aircraft production industry.

The researcher presented description of aircraft production industry with its economic dynamics and future prospective. As a part of that, it was crucial to describe chosen companies Airbus and Boeing from the side of their history, structure, current operations with main focus on production of civil aircrafts niche, the most prominent part of the market and companies' revenues. More than that, the researcher provided justification and description of chosen projects of Airbus A350 XWB and Boeing 777X, which are brand new to the market regarding the product proposition and production.

Chapter 3. Research findings

3.1. Model description

The analysis of chosen projects will be split into two parts. The first one refers to the analysis of companies' projects with the help of ROA and will be done partcially in correspondence with the scheme presented in a book of J.Mun "Real Option Analysis". In the second part the researcher will evaluate strategy implementation success. By project's success we mean the financial impact of the chosen strategy in terms of new products' launch on company's value compared to the competitor's performance with a comparable project.

The scheme of the first part is presented below.

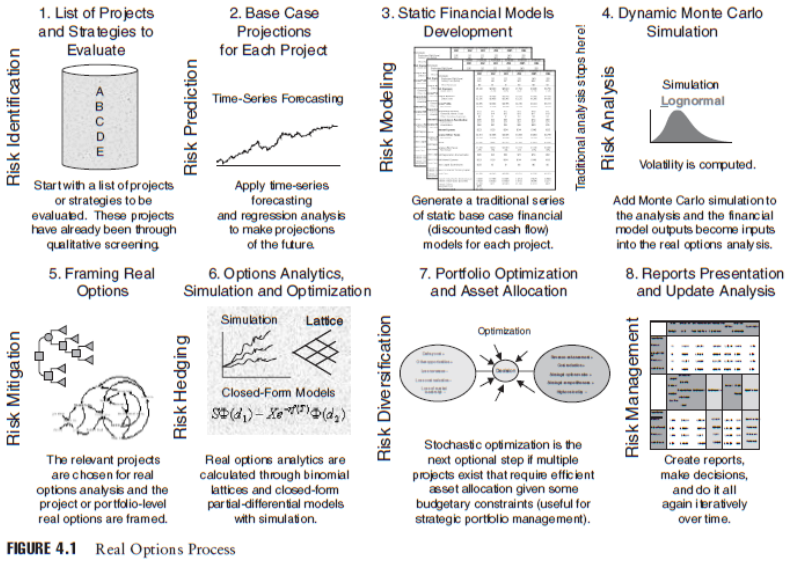


FIGURE 4.1 Real Options Process

Figure 7. Real Option Analysis process (Mun, 2006)

The first step means that management of the company has to decide on projects to consider and analyze. These investment opportunities have to be with accordance with a company's vision, mission, goals, values as well as chosen strategy. As it was stated in Chapter 2 the researcher decided to consider two companies Airbus and Boeing with their new investment projects such as A350XWB and 777X which are to be launched in the nearest future. Both aircraft families are relatively similar and still compete directly against each other. These projects are in line with current companies' goals and chosen strategies, since both Airbus and Boeing are trying to capture the market of long range aircrafts.

Second step is to analyze projects with the help of standard tools such as Net Present Value (NPV). In order to calculate values of NPV it is necessary to start with calculation of free cash flow (FCF) for both projects. FCF implies valuation of revenues, variable and fixed costs as well as initial investments. The formula for NPV valuation is presented below:

$$NPV = -Investment + \sum_{t=1}^{T} \frac{FCF_t}{(1+WACC)^t} \quad (4)$$

where:

FCF_t – free cash flow in the time t;

WACC – weighted average cost of capital.

From this formula one can derive several components which are important to be specified. The first one is free cash flow (FCF). This is a cash inflow from a project performance.

$$FCF = EBIT * (1 - T_c) \pm (Depreciation/Amortization) \pm CAPEX \pm \Delta WC \quad (5)$$

where:

EBIT – earnings before income and tax;

T_c – corporate income tax;

CAPEX – capital expenditure;

ΔWC – change in working capital.

Calculation of FCF will be done based on historical data from companies' financial statements and their current projects as well as will include Monte Carlo simulation for demand variable.

Next component of the NPV formula is WACC, which stands for weighted average cost of capital. The researcher used the following formula to calculate it:

$$WACC = k_d w_d (1 - T_c) + k_e w_e + k_{ps} w_{ps} \quad (6)$$

where:

k_d – cost of debt;

w_d – weight of debt in company's capital structure;

k_e – cost of equity;

w_d – weight of equity in company's capital structure;

k_{ps} – cost of preferred shares;

w_{ps} – weight of preferred shares in company's capital structure.

Since neither Airbus nor Boeing has preferred stocks, the researcher can use the simplified formula of WACC:

$$WACC = k_d w_d (1 - T_c) + k_e w_e \quad (7)$$

where:

k_d – cost of debt;

w_d – weight of debt in company's capital structure;

k_e – cost of equity;

w_d – weight of equity in company's capital structure;

Undoubtedly, there are several approaches how to calculate discounted cash flows (DCF). Among them are accounted rate of return, internal rate of return and other ways, however it is reasonable to use NPV approach, since estimated FCFs are the base for further ROA as well as NPV can serve as a base for overall projects' analyses.

After FCF calculation a researcher will proceed with ROA itself. As it was stated, results of DCF analysis serve as inputs for real options valuation. As it was stated in the book "Real option Analysis", it is reasonable to conduct sensitivity analysis to understand which variables of free cash flow have major impact on NPV value (Mun, 2006). After this task, it is suggested to switch to Real Option Problem Framing: to identify certain options within the investment opportunities. In our case the researcher chose two projects: there are two new aircraft families. Each family implies two models which will be launched into production one by one. From this perspective, it was decided that in this analysis the author will take into consideration such real options as to abandon, to expand and sequential option.

The first option to be considered is an option to abandon. We decided to evaluate that since it is a widely-used practice in aircraft production industry. Airplane development is a capital-intensive initiative which in case of failure will not only lead to losses but also can damage company's brand and reputation. One of the brightest examples of such situation is Boeing 787. It is the largest project of Boeing, made for long distance flights. It was launched in 2011. Since the start of the production the whole project was almost never profitable for the company: production costs were USD 30 million more than it was forecasted (Fontevecchia, 2013). Additionally, overall investments into the program are EUR 32 billion, 3 times more than the current project (Fontevecchia, 2013). Possibly, the abandonment could save money for the company. Second option is to expand: both companies are planning to launch second models (A350-1000 and 777-8) in the nearest future; however, these plans are under negotiations and discussions. Hence, one can consider the introduction of second models as an option to expand. The latter option is sequential one, allows considering previous two options. Firstly, values of options are not additive, so it is impossible to find an overall result of decision making flexibility by summing up options values (Trigeorgis, 1996). Secondly, they are done in a form of stages; expansion decision heavily relies on decision whether to abandon the whole project. Thanks to this, the researcher will be able to calculate this option and use it as a means to compare chosen projects between each other.

For ROA the author used calculations of DCF as well as other historical data about companies and their previous projects. As an underlying asset, it is reasonable to take PV of all FCFs per project (Mun, 2006).

The valuation of real options can be done via different tools such as binomial tree, Black-Scholes model and so on. However, in order to capture all scenarios and be able to combine two options in one (to abandon and to expand into sequential one) it was decided to use binomial lattice approach:

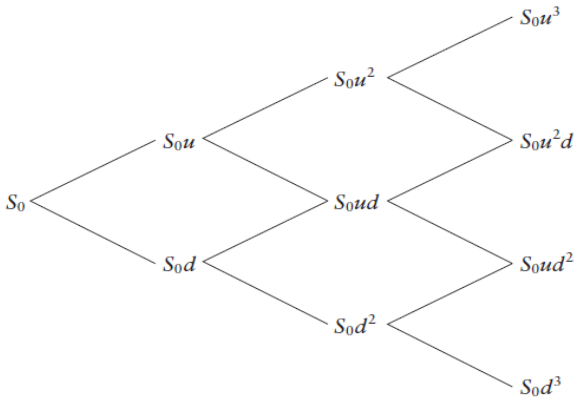


Figure 8. Binomial tree structure (Mun, 2006)

Binomial lattice approach can be done through either using risk neutral probabilities or market replicating portfolios. Both approaches will give the same answer, however in this master thesis it was decided to use the first method. It assumes usage of risk-adjusted probabilities for cash flows. In other words, this method implies the same logic as discounting cash flows at a risk-free rate. Exactly binomial tree with risk-neutral probabilities is shown at the figure 8.

Now it is important to specify all inputs of this approach. At first, the parameter S stands for the present value of the underlying asset, and S_0 in particular represents present value of the underlying asset in a time period 0. Next is exercise price of the option (K), value at which the option will be surely exercised at the end of its lifespan. When one considers real options for investment projects, then K is a present value of implementations costs (initial investments). Sigma (σ) is volatility of an underlying asset. Risk-free rate (r_f) is basically a rate for a riskless asset such as governmental bonds.

All these parameters are important to construct a binomial lattice. To do so, one needs to calculate up and down factors, which we use to construct further parts of the tree (Figure 8). For their calculation, the researcher used following formulas:

$$u = e^{\sigma\sqrt{\delta t}} \tag{8}$$

$$d = e^{-\sigma\sqrt{\delta t}} = \frac{1}{u} \tag{9}$$

where:

u – up factor;

d – down factor;

e – exponential constant;

σ – volatility of an underlying asset;

δt – time step in lattice approach valuation.

These up and down factors are then used to calculate risk-neutral probabilities, needed to discount cash flows within the binomial lattice approach. The formula for its calculation is following:

$$p = \frac{e^{(r_f - b)(\delta t)} - d}{u - d} \tag{10}$$

where:

p – risk-neutral probability;

e – exponential constant;

r_f – risk-free rate;

b – continuous dividend payment;

δt – time step in lattice approach valuation;

u – up factor;

d – down factor;

Further calculations for the binomial tree are done for each time period (nod) with the use of all calculated parameters, mentioned above, and with correspondence to the tree structure, shown on Figure 8.

It is vital to mention that the structure of binomial tree estimation is general with no regard to any type of options. However, it is necessary to adjust the tree with respect to the type of option, used in the project. First classification relates to types of financial options:

Call option – a right to buy an asset:

$$\text{Payoff} = \max(S_t - K; 0) \tag{11}$$

Put option – a right to sell an asset:

$$\text{Payoff} = \max(K - S_t; 0) \tag{12}$$

The next classification refers to types of decision making flexibility. In the paper of Trigeorgis (1995), the author stated different types as well as the ways how to calculate payoffs on options. As it was stated, in this paper the researcher is going to evaluate option to abandon, to expand and sequential option.

- Option to abandon – put option:
  - Exercise price = Salvage value of liquidation/abandonment value
- Option to expand – call option:
  - Value of underlying asset = expansion factor multiplied by value of underlying asset less expansion costs (investment costs)
- Sequential option – an option on an option:

- Value of underlying asset = value of underlying asset from option 2 (stage 2) less investment costs from option 1 (stage 1).

After all mentioned calculations, it is important to calculate present value of an option. Here one can use backward valuation (Trigeorgis, 1996). Below there are formulas which are used to valuate two-period binomial tree.

$$V_u = \frac{pV_{uu}+(1-p)V_{ud}}{(1+r_f)} \quad (13)$$

$$V_d = \frac{pV_{ud}+(1-p)V_{dd}}{(1+r_f)} \quad (14)$$

$$V = \frac{pV_u+(1-p)V_d}{(1+r_f)} \quad (15)$$

where:

V – final value of the option in period 0;

V_u, V_d – values of up and down values of an underlying asset in nod of period 1;

V_{uu}, V_{ud}, V_{dd} - values of up and down values of an underlying asset in nod in period 2;

p – risk-neutral probability;

r_f – risk-free rate;

The approach described above has several drawbacks and limitations. At first, the values of underlying assets might be negative. Secondly, it is relatively difficult to derive the value of volatility and needs to be precise to be able to reflect the nature of the underlying asset. What complicates even more is that there are not sometimes any historical data for the estimation of volatility. Next issue is connected with expiration period of an option. There are no any rules how to estimate it. Only use of in-depth industry knowledge and historical data can help with this issue.

Last part of the analysis is devoted to companies' valuation and comparison of projects' financial impact. From this perspective, the researcher is going to evaluate firms' value with the help of DCF model, the same approach used for NPV and ROA. The valuation will be done for 5 years. Last step was assessment of financial impact of chosen projects based on the formula:

$$V = V_c + PVGO \quad (16)$$

where:

V – final value of the company;

V_c – value of the company for the current time period;

PVGO – present value of growth opportunities (sequential option value).

3.2. Empirical results

3.2.1. ROA assumptions

The data and information about companies used for project assessment and companies' valuation have been taken from open sources: annual reports and financial statements of Airbus and Boeing, industry overviews, news published in online newspapers and websites, databases. All information used for the analysis is taken for the most recent period: for projects analysis it was taken since 1990s in order to have in-depth understanding of demand and production, for companies' valuation – for the last 5 financial years (2011-2016). For projects analysis it was assumed that there was no any interaction between other projects, not taken for the analysis.

Since the major uncertainty of aircraft production and sales is demand, it was decided to use Monte-Carlo simulation. Core inputs of the model referred to volatility, since other parameters such as starting demand, drift, time steps have been taken from historical data of both considered projects. The volatility has been assessed with regard to predecessors of considered aircraft models. Important to mention, that Airbus does not publish order and production data for the whole lifetime of the company. This made the volatility assessment more complicated. This issue has been resolved via consideration of a basic predecessor for both projects. It is Boeing 777-200ER and 777-300ER. The volatility was assessed with the use of historical data for these models of Boeing aircrafts.

Prices for aircrafts of both companies were taken for the official reports and websites as well as official claims about price increases. Both companies present their prices in USD, however Airbus publish all its results in EUR, for better correspondence prices of Airbus were corrected on exchange rate, provided by Thompson Reuters.

It is vital to point out that demand, production and deliveries are not aligned, since orders are collected 5-7 years before the actual production starts; it takes from 2 weeks up to 2 months to accomplish one aircraft; delivery happens after the actual production is finished, delivery might take time since all clients are situated all around the globe. Additionally, companies account their revenues based on deliveries. So, in order to calculate revenues, it was decided to estimate delivery rate for previous Airbus and Boeing projects and use it as a benchmark for the chosen projects.

Estimation of costs was based on top-down approach. Companies disclose neither costs per airplane, nor their markups. The researcher was capable to derive approximate markups and discounts per airplane, which make it possible to estimate cost of production per airplane. Additionally, the researcher was able to find information about costs for Boeing previous project, using it as a benchmark. Fixed costs were estimated as average based on historical data

of companies and calculated as fixed costs per commercial airplane produced for the whole company.

Investment projects have been taken similar to each other in terms of initial investments as well as technical characteristics. Important to say that Airbus launched already its project in 2014, while Boeing is only about to launch first aircraft model deliveries in 2020. The latter company has been changing the dates of deliveries start several times, and currently it states 2020 as a final year. The introduction of second models within families for both companies is still under discussions and clarifications, but it is assumed that both companies will introduce second models in 3 years after the first launch.

The length of the projects themselves was estimated based on existing Airbus and Boeing models. On average, companies keep production and deliveries for 15 years.

Further assumptions and limitations refer to ROA itself. Firstly, risk-free rate and country risk have been taken from official government and Damodoran websites in correspondence of the year considered. Such parameters as beta and debt interest rates have been calculated with the use of historical data, provided by companies.

Next point is that both companies do not pay dividends on preferred stock; so, the researcher used simplified formula for WACC. Secondly, both companies do pay dividends on common stocks. Still companies pay dividends based on overall performance, which includes all product portfolio, we decided not to consider it.

Within the ROA analysis itself, one of complications was connected with initial investments split between two models within the same aircraft family. Since both companies disclose overall investments for the projects but not per model, it was decided to slit investments in accordance with current annual R&D expenditures of both companies.

In order to evaluate the impact of the strategy on companies' performance, it was necessary to assess companies' values. For that purpose, the researcher used annual reports and databases such as Thompson Reuters, other data which was calculated for ROA and used several assumptions for the forecasting of FCF. These assumptions were based on historical performance of companies as well as forecasts done by both Airbus and Boeing.

3.2.2. Projects valuation

In this part, the researcher presents all findings concerning the projects valuation and their financial impact on companies' performance. Both projects Airbus A350XWB and Boeing 777X will be analyzed with a base tool NPV as well as via Real Option Analysis: option to abandon, option to expand, sequential option. All the steps and results will be described below.

3.2.2.1. Airbus A350XWB

As it was already stated, this project is an introduction of a new longer range aircrafts to the market. This project consists of two aircraft models: A350-900 and A350-1000. Core difference between them lies in their length and range of a flight. A350-900 is a short version (66.8 meters) and the range is expected to be 15000 kilometers. Second model is longer and is going to be 73.8 meters long and the maximum range is 14800 kilometers.

The whole project has initial investments of EUR 11 billion. The announcement about the model was done in 2004. It received a lot of criticism, so the next version appeared in 2006, and since then the company was actively receiving order for the production of both models. For 2017, it has 820 units. The start of production and deliveries was in 2014. The aircraft already gained success and popularity among current clients.

Net Present Value

Going to the financial analysis of the project itself, at first, it is reasonable to discuss NPV results.

The base for NPV calculation is FCF estimation, which consists of revenue and costs estimation (see Appendices 1 and 2). Revenues are composed of orders and prices. For demand simulation, the researcher used Monte Carlo simulation. It was estimated that the overall deliveries of each models will be:

- A350-900 – 553 units
- A350-1000 – 461 units

Prices for respectful models are:

- A350-900 – EUR 295.2 million
- A350-1000 – EUR 340.7 million

All the prices for aircrafts were expected to grow with average growth rate of 1%, as it was historically for other models within the product portfolio. Prices are subject to discounts. Historically, Airbus offers on average 50% from the stated price.

As it was stated, orders, production and deliveries are not the same in aircraft production industry. Companies account revenues only after an airplane is delivered. Based on this fact, in this paper the researcher used a historical distribution of deliveries for the whole life span of production period, calculated on data of previous aircraft models.

Costs of production are not disclosed in any reports. However, it was possible to estimate average markup for aircrafts like A350XWB. Lately, Reuters published overview of Boeing 787 costs of production. Thanks to this information, it was estimated that average markup is 250%. Based on this number it was possible to derive costs of production per aircraft. Fixed costs,

which usually include costs for delivery and other costs which occur within the company, were estimated for 1 unit of airplane delivered, equaling to EUR 3 million. Final cost which relates to operations is tax. Tax rate was estimated based on income statement, equaling to approximately 25%.

The WACC, taken for estimations, was 6.4% for 2014 year (start of delivery) (see Appendix 14).

Initial cost of project's development was EUR 11 billion. Since there are two models, it was decided to split this amount in proportion of 80% for the first produced model, 20% - for the second one.

Based on all steps mentioned above, NPV of the whole project is EUR 2.5 billion:

- NPV (A350-900) = EUR -1.7 billion (2014)
- NPV (A350-1000) = EUR 4.2 billion (2014)

Option to abandon

The next step after NPV calculation is ROA, in particular option to abandon. This is the first decision the company makes in terms of the whole project. Airbus A350-900 is a new model in terms of technical characteristics. Due to its new improvements, it might be unsuccessful in terms of customers' demand. In case of its failure it may lead to additional losses related to this model (example of Boeing 787) as well may impact further expansion decisions such as introduction of A350-1000. So, it is important for Airbus to consider possible flexibilities of the project, in particular, opportunities to cancel out the project.

Analyzing previous aircrafts and projects, it was figured out that in general Boeing and Airbus decide on whether to continue a project within 2 years after start of production. So, the length of the option to abandon is assumed to be 2 years.

Value of the underlying asset has been taken as a present value of all FCFs related to the project, equaling EUR 7 billion. Exercise price was taken as an amount of initial investments for the model, equaling to EUR 8.8 billion. Volatility of A350-900 demand is estimated to be 76%.

Considering all inputs, the value of the option is EUR 4 billion. So, the value of the project including an opportunity to cancel the project of A350XWB within 2 years is values at EUR 4 billion.

Option to expand

Second option is connected with opportunity to expand the project and start the production of the second model. Speaking about Airbus, it is launch of A350-1000. Within the calculation, it is assumed to estimate an expansion factor by which the production will increase. In case of aircraft production, it is impossible to estimate an expansion factor but it is possible to

evaluate future cash flow from the project using same techniques as for the first airplane model. To estimate the value of the impact from the second model it was decided to calculate present values of FCFs for two models less present value of the model to be produced the first. The launch of production and deliveries is planned to be in 2017, in 3 years after the first part of the project.

As for option valuation inputs, present value of FCFs equals to EUR 6.4 billion. Exercise price is initial investments EUR 2.2 billion, 20% from the whole investments. Volatility is different as it was for previous model and equals 94%.

Considering all inputs, the value of the option is EUR 4.9 billion. So, the value of the project including an opportunity to expand the production of the family up to two models (A350-900 and A350-1000) within 3 years is valued at EUR 4.9 billion.

Sequential option

Third option considered is sequential option. By definition, it is "an option whose option depends on the value of another option" (Dumrauf, 2015). Sequential option is used when there are stages of a project. Considering the case of Airbus, this exact project has two stages: first one is decision to continue the project (option to abandon); second stage relates to the idea of further expansion and new model launch (option to expand). Important to say, the second decision cannot be implemented without final decision about A350-900 implementation. In order to take into consideration these two decisions the researcher uses sequential option.

The time of the option equals to the time of option to abandon of 3 years. Value of the underlying asset in this case is not the present value of FCFs, but values of real options from the longest option (option to expand). The role of an exercise price of the option is an exercise price of shortest option (option to abandon).

Considering all inputs, the value of the option is EUR 2.5 billion. So, the value of the project including an opportunity to expand the production of the family up to two models (A350-900 and A350-1000) within 2 years is valued at EUR 2.5 billion.

Sensitivity analysis

Following the logic of ROA analysis process, it is necessary to make a sensitivity analysis in order to reveal zones which are sensitive to changes to a greater extent. For this purpose, we varied such inputs as initial investments, volatility, value of underlying asset and risk-free rate within 50%, 100% and 150% of the basic scenario values.

The researcher revealed the following results:

Table 6. Scenario analysis

Boeing 777X	**Option values (USD)**
Best case	4 172 993 400
Expected	2 486 487 431
Worst case	799 981 462

Source: the author's calculations

The sensitivity analysis revealed that the major impact on option value have value of the underlying asset, initial investment and volatility. Risk-free rate does have impact, but relatively less comparing to major ones.

In Appendices 7, 8 and 9 there is a detailed description of sensitivity analysis for all options considered in this research: option to abandon, option to expand and sequential option. It is vital to mention that the changes in the option to abandon does not influence sequential option, since it considers only the decision made during the first stage.

3.2.2.2. Boeing 777X

Boeing, the same as its competitor did, introduces two versions of long range aircrafts 777-8 and 777-9, discussed in Chapter 2. Version 777-8 has length of 69.8 meters and range of 16000 kilometers. Bigger version 777-9 is expected to be 3 meters longer, equaling 79.6 meters with the planned range of 14000 kilometers.

The whole project has initial investments of USD 11.8 billion. The announcement about the model was done in 2011, since then the company was actively receiving order for the production of both models. For 2017 it has 306 units. The start of production and deliveries will be in 2020 for 777-9 and 2023 for 777-8.

The overview of the project will follow the same logic as for Airbus A350XWB.

Net Present Value

Going to the financial analysis of the project itself, at first, it is reasonable to discuss NPV results. The base for NPV calculation is FCF estimation, which consists of revenue and costs estimation (see Appendices 3 and 4). Revenues are composed of orders and prices. For demand simulation the researcher used Monte Carlo simulation. It was estimated that the overall deliveries of each models will be:

- 777-9 – 501 units
- 777-8 – 444 units

Prices for respectful models are:

- 777-9 – USD 400 million
- 777-8 – USD 380 million

All the prices for aircrafts were expected to grow with average growth rate of 0.5%, as it was historically for other models within the product portfolio. Prices are subject to discounts. Historically, Boeing offers on average 49% from the stated price.

As it was stated, orders, production and deliveries are not the same in aircraft production industry. Companies account revenues only after an airplane is delivered. Based on this fact, in this paper the researcher used a historical distribution of deliveries for the whole life span of production period, calculated on data of previous aircraft models.

The same as for Airbus, Boeing does not disclose in any reports, however, we estimated the average markup for aircrafts like 777-9. The same example of Boeing 787 has been used. It was estimated that average markup is 250%. Based on this number it was possible to derive costs of production per aircraft. Fixed costs, which usually include costs for delivery and other costs which occur within the company, were estimated regarding 1 unit of airplane delivered, equaling USD 3.5 million Final cost which is connected with operations is tax. Tax rate was estimated based on income statement, equaling approximately 25%.

The WACC, taken for estimations, was 8% for 2017 year (start of delivery) (see Appendix 16).

Initial cost of project's development was USD 11.8 billion. Since there are two models, it was decided to split this amount in proportion of 80% for the first produced model, 20% - for the second one.

Based on all steps mentioned above, NPV of the whole project is USD 5 billion:

- NPV (777-9) = USD 1 billion (2016)
- NPV (777-8) = USD 4 billion (2016)

Option to abandon

The next step is ROA, in particular option to abandon. Boeing also has this decision as the first one in terms of the whole project, since final choice of the company whether to proceed with the project or not impacts not only the further decisions like expansion, but in general company's performance, especially if the project proves to not be viable.

Based on historical analysis of preceding projects and overall product portfolio, it takes on average 2 years to quit the projects in case of failure. So, the length of the option to abandon is assumed to be 2 years.

Value of the underlying asset has been taken as a present value of all FCFs related to the project, equaling USD 10.5 billion. Exercise price was taken as an amount of initial investments for the model, equaling to USD 9.4 billion. Volatility of 777-9 demand is estimated to be 94%.

Considering all inputs, the value of the option is USD 3.7 billion. So, the value of the project including an opportunity to cancel the project of 777-9 within 2 years is values at USD 3.7 billion.

Option to expand

Second option is option to expand. Boeing intends to produce a shorter version of 777-9 – model 777-8. Using the same logic, we used present value of future cash flows instead of expansion factor: present values of FCFs for two models less present value of the model to be produced the first. The launch of production and deliveries is planned to be in 2023, in 3 years after the first part of the project.

As for option valuation inputs, present value of FCFs equals to USD 6.3 billion. Exercise price is initial investments USD 2.4 billion, 20% from the whole investments. Volatility is different as it was for previous model as equals to 94%.

Considering all inputs, the value of the option is USD 4.6 billion. So, the value of the project including an opportunity to expand the production of the family up to two models (777-9 and 777-8) within 3 years is valued at USD 4.6 billion.

Sequential option

Third option is sequential option. Like Airbus, the project of Boeing has several stages: first one is decision to continue the project (option to abandon); second stage relates to the idea of further expansion and new model launch (option to expand). Additionally, the second decision cannot be implemented without final decision about 777-9 implementation. In order to take into consideration these two decisions the researcher uses sequential option.

The time of the option equals to the time of option to abandon of 3 years. Value of the underlying asset in this case is not the present value of FCFs, but values of real options from the longest option (option to expand). The role of an exercise price of the option is an exercise price of shortest option (option to abandon).

Considering all inputs, the value of the option is USD 1.8 billion. So, the value of the project including an opportunity to expand the production of the family up to two models (777-9 and 777-8) within 2 years is valued at USD 1.8 billion.

Sensitivity analysis

In order to check the impact of inputs fluctuations, we analyzed zones which are sensitive to changes to a greater extent. For this purpose, we varied such inputs as initial investments, volatility, value of underlying asset and risk-free rate within 50%, 100% and 150% of the basic scenario values. The researcher revealed following results:

Table 7. Scenario analysis

Boeing 777X	**Option values (USD)**
Best case	3 389 946 674
Expected	1 848 806 772
Worst case	307 666 871

Source: the author's calculations

The sensitivity analysis revealed that the major impact on option value have value of the underlying asset, initial investment and volatility. Risk-free rate does have impact, but relatively less comparing to major ones. The results are the same as for the case of Airbus.

In Appendices 10, 11 and 12 there is a detailed description of sensitivity analysis for all options considered in this research: option to abandon, option to expand and sequential option. It is vital to mention that the changes in the option to abandon does not influence sequential option, since it considers only the decision made during the first stage.

3.2.2.3. Projects' comparison

Considered projects of Airbus and Boeing indeed have numerous similarities between each other. Both A350XWB and 777X target the same niche of long range aircrafts; both use technical breakthrough in terms of materials used for airplanes bod. Additionally, these two models provide with fuel consumption improvements and new designs.

Despite such a big similarity, both projects perform differently and have different impact on the launchers' performance.

In this paper, the researcher assumed that project's success can be valued as an its overall financial impact on companies' value. In the Chapter 2 we discussed that the final value a company can be calculated as a sum of firm's and option values. The impact is calculated as a percentage increase in the firm's value. Speaking about determination of project's success, by this we mean the comparison of the relative impact of projects on rivals' values and its comparison. Firms' values have been calculated using Discounted Cash Flow model based on historical data (see Appendices 13 and 15).

Results of calculation are shown below:

Table 8. Projects' impact analysis results

	Airbus A350XWB (EUR)	**Boeing 777X (USD)**
Sequential option value	2 486 487 431	1 848 806 772
Firm's value	75 258 520 323	110 672 073 155
Final firm's value	77 745 007 754	112 520 879 928
Impact (%)	3.3%	1.7%
Impact (%, EUR*)	3.3%	2.2%**

* FX = 0.9 USD/EUR
** Compared to the value of Airbus

Source: the author's calculations, Thompson Reuters

From the table, we can derive that both projects are worth to be implemented given decision making flexibility. Furthermore, one can derive that the project of Airbus has, at first, higher impact on company's performance and value in different currencies; secondly, it has higher impact in the same currency (EUR). Additionally, the value of sequential option from Airbus is higher comparing to Boeing. Based on these calculations we can derive that A350XWB proved to be more successful on the market than 777X.

Core reasons to these findings are following. Firstly, Airbus has gained a first mover advantage. During 7 years before production start it has obtained 820 orders for the family, while Boeing only 306. Additionally, Boeing did not get orders for its 777X during 2015 and 2016. Clients also show their loyalty to the company which can deliver modern aircraft sooner and provide with cheaper price. Additionally, Airbus comparing to Boeing has lower production and SG&A costs per unit, leading to higher profitability. One more advantage of Airbus is its rate: WACC of 6% against 8% of Boeing. Summing up the research it can be said, that Airbus continues gaining the leading position on the market through its project's implementation.

It is vital to emphasize that the conducted research has several limitations. At first, all assumptions were made based on historical data. However, the change of the assumptions can lead to different results, as we can observe from sensitivity analysis. Secondly, companies have extensive product portfolios of different aircrafts. In such big corporations, projects may correlate between each other, distorting real results of considered ones. Thirdly, the core uncertainty mentioned in the analysis is demand. Even having stated orders per model, it is impossible to predict how many net orders the companies will have during next 15 years of the production. These aspects should be considered.

3.3. Discussions and managerial implication

All presented findings of analysis were devoted to the analysis of product line extension strategy in terms of a new product introduction.

Product line extension strategy, which is one of the most popular ones, stands for a launch of a new product, which slightly differs from the core product in terms of characteristics. It was proved that such a strategy can be perceived as a typical investment project. It means, that new product launch has initial investments, spent on research and development, as well as certain incoming cash flows and uncertainties. Based on this logic this strategy can be assessed not only using basic known tools, but also financial ones, which can provide with more in-depth analysis and flexibility.

One of the tools that can be used in this situation is basic NPV. It is based on time value of money and shows the value of a project as a difference between discounted cash flows and initial investments. However, many investment projects are more complex in terms of process and decisions done during its implementation. Particularly, it does not consider decision making flexibility, that, for instance, a company can exit a project in case of worsening conditions. To solve this issue, we applied Real Option Analysis, a relatively new tool, which is based on principles of financial options. It gives a flexibility of making decisions while implementing any project: in case a company wants to expand its activity it will analyze option to expand or to quit the project – option to abandon, and so on.

Speaking more about the chosen case, it was aircraft production industry. Currently, there is lack of attention to this industry in terms of ROA use and, in particular, analysis of product line extension on the example of airplanes producers. It is a highly representative case: aircraft manufacturers are forced to make new model of aircrafts in order to keep their clients attached because prices, discounts and other offerings are more or less the same. That is why it was topical to analyze how companies can apply ROA to their projects.

Important to say that RO analysis is important for such types of projects. Aircraft production is a complex capital-intensive initiative, which lasts for 15-20 years and has a lot of risks and uncertainties. Use of basic project's valuation tools will not provide with in-depth analysis. The main result comprises decision on either invest or not at the present time period. However, such projects might be not that primitive – they might include more scenarios of company's choice. Along with that companies in aircraft industry tend to postpone or expand their projects because of better times and economic conditions – this reflects that projects should have a degree of flexibility in decision making process. Additionally, such a long-term life span of aircraft production process leads to numerous uncertainties such as demand, costs, currency exchange rate, which should be included in the analysis. Summing up, all these aircraft

production projects' aspects are considered in ROA and help manufacturers to assess their complex initiatives through more detailed way with several outcomes and variants to choose.

It was discussed previously that Boeing and Airbus are direct rivals, which compete against each other via introduction of new models within a horizontal product line extension strategy. However, success of new aircraft families launch was under concerns. The author of this paper suggested an approach how it is possible to evaluate implementation success. It is done via valuation of sequential option and its relative impact on firm's value. This approach not only helps to understand whether the whole project is worth being implemented but also allows to compare results with the closest competitor.

Taking everything into consideration, Real Option Analysis and success valuation in terms of option's impact on firm's value can help companies such as Airbus and Boeing be able to get more holistic analysis of their projects and product strategies.

3.4. Conclusion

The paper was devoted to the analysis of such strategy as product line extension and success valuation of its implementation by Airbus and Boeing in terms of financial impact on company's value. The goal has been achieved through accomplishment of stated objectives. Firstly, it was important to give an overview to existing marketing strategies, connected with the launch of new products. Secondly, the researcher analyzed tools which are used for these strategies' valuation within several types. Next step was to justify the choice of the tool to be used in the analysis as well as companies and their projects. Fourth step contained analysis of chosen cases with the help of standard tool such as NPV. Afterwards, the researcher did in-depth analysis of companies' projects via ROA. Final step showed projects comparison and final conclusions.

The considered in this paper brand strategy is product line extension. It is one of four strategies according to Tauber (1981), related to the brand extension approach. Nowadays it is highly used among multinational companies. Among them are Coca-Cola, Palmolive-Colgate, Unilever, Procter & Gamble, Apple, Samsung, Mercedes Benz, BMW, Toyota and many other corporations. This trend is due to technological breakthroughs and higher consumers' empowerment with information and access to Internet. The overall brand loyalty decreases, therefore companies are forced to apply different brand strategies, keeping consumers attached to the brand.

There are numerous tools used for product line extension strategy performance. They are classified as judgmental, quantitative, causal, market analysis and other approaches. The biggest attention is given to judgmental tools, since they are easier in terms of implementation and expertise needed. However, quantitative tools are of lower popularity even though they provide more in-depth analysis and insights. For instance, ROA has been gaining more popularity thanks to the flexibility and different scenarios analysis it provides with.

As for a case for the strategy analysis the researcher decided to choose aircraft production industry. It is unobvious case since this strategy is mainly used in FMCG, IT or, for instance, automotive industries. However, it was proved that even airplane manufacturers such as Airbus and Boeing use it as a means to attract clients and keep them attached to the brand. Still, this widely-used approach even within the air transport sector creates doubts about its success in terms of overall impact on financial state of a company as well as comparing to other market players. Moreover, it was proved that product line extension is terms of new product launch can be viewed as an investment project, which can be valued with well-known financial tools.

For this purpose, we took two core market players Airbus and Boeing and their new projects related to new aircraft family introduction: A350XWB and 777X. Both models proved

to be relatively similar in terms of offered technical characteristics, flight parameter improvements as well as initial investments. They are ordered by airlines from all over the world: Lufthansa, Etihad, Emirates, etc. However, both companies are based in different countries as well as have dissimilar demand, cost structure, discount rates and risks. These factors were included into aircraft analysis via ROA. All data and assumptions were made based on historical data, official companies' reports and official press releases.

Moving to the analysis itself, it is important to mention that both projects proved being worth to be implemented. Even though NPVs were not all positive, overall ROA revealed that projects' values are worth being implemented, including all possible outcomes and given flexibility in terms of several possible decisions (to abandon and to expand). Speaking more about the main result, the overall impact of the new aircraft family introduction is higher for Airbus comparing to Boeing. This leads to an overall conclusion that Boeing, even having overall market dominance in terms of orders and deliveries, will have less successful project's implementation than Airbus. One of the ideas, which can be core here, is that Airbus has launched its project earlier and gained more orders from main clients. For now Airbus has 820 orders compared to Boeing's 306. This situation we can call as a first mover advantage. Since aircrafts are expensive investments as well as their use is around 20 years, airlines will buy airplane from the first offer and be reluctant to change the supplier. Additionally, core drivers for option values are value of underlying assets and volatility of demand. If demand level fluctuation is an exogenous factor, the value of underlying asset reflects the whole business model of a company. Airbus has better price offering as well as production costs structure. Historically, Boeing has issues with high costs: Boeing 787 for a long time could not break even due to higher than expected production costs. Additionally, European market for air transport proved to be less risky than American. This accompanied by different capital structure, Boeing turned to be riskier. Based on these factors, Airbus A350XWB proved to be more successful comparing to Boeing 777X.

Additionally, it was proved that due to specifics of aircraft production projects and their similarity with investment projects it is reasonable to use ROA as a valuation tool. It gives such advantages as variety and flexibility of managerial decisions as well as includes uncertainties which arise during projects' implementation. Additionally, success valuation approach based on ROA can help companies like Airbus and Boeing analyze their projects and compare them between existing ones and to what competitor has. This allows to make conclusions whether the launched product will be successful or not.

List of references

1. **Airbus** Airbus Group SE Annual Report 2016 [Online] // Airbus. - 2017 a. - 05 17, 2017. - http://www.airbusgroup.com/int/en/investors-shareholders/Annual-reports-and-registration-documents.html.
2. **Airbus** Aircraft Families [Online] // Airbus. - 2017 b. - 05 17, 2017. - http://www.airbus.com/aircraftfamilies/.
3. **Airbus** Annual Reports and Registration Documents Airbus [Online] // Airbus Group. - 2017 f. - 05 17, 2017. - http://www.airbusgroup.com/int/en/investors-shareholders/Annual-reports-and-registration-documents.html.
4. **Airbus** Mapping Demand 2016/2035 [Online] // Airbus. - 2016 c. - 05 17, 2017. - http://www.airbus.com/company/market/global-market-forecast-2016-2035/.
5. **Airbus** Orders and Deliveries [Online] // Airbus. - 2017 d. - 05 17, 2017. - http://www.airbus.com/company/market/orders-deliveries/.
6. **Airbus** The succes story of Airbus [Online] // Airbus. - 2017 e. - 05 17, 2017. - http://www.airbus.com/company/history/the-narrative/.
7. **Aviation Explorer** Airbus A350 XWB Aircraft Airliner [Online] // Aviation Explorer. - 2017. - 05 17, 2017. - http://www.aviationexplorer.com/a350_facts.htm.
8. **Bass's Basement Research Institute** The Bass Model [Online] // Bass's Basement Research Institute. - 2010. - 05 17, 2017. - http://www.bassbasement.org/BassModel/Default.aspx.
9. **Boeing** Boeing Commercial Aircrafts [Online] // Boeing. - 2017 a. - 05 17, 2017. - http://www.boeing.com/commercial/.
10. **Boeing** Boeing history chronology [Online] // Boeing. - 2014 b. - 05 17, 2017. - http://www.boeing.com/resources/boeingdotcom/history/pdf/Boeing_Chronology.pdf.
11. **Boeing** Current Market Overview 2016-2035 [Online] // Boeing. - 2016 c. - 05 17, 2017. - http://www.boeing.com/resources/boeingdotcom/commercial/about-our-market/assets/downloads/cmo_print_2016_final.pdf.
12. **Boeing** Fourth-Quarter 2016 Performance Review [Online]. - 2017 d. - 05 17, 2017. - http://s2.q4cdn.com/661678649/files/doc_presentations/2016/Jan/4Q16-Presentation-FINAL.pdf.
13. **Boeing** Introducing the 777X [Online] // Boeing. - 2017 e. - 05 17, 2017. - http://www.boeing.com/commercial/777x/#/feature-stories.
14. **Boeing** Orders and Deliveries [Online] // Boeing. - 2017 f. - 05 17, 2017. - http://www.boeing.com/commercial/#/orders-deliveries.

15. **Boeing** Quaterly Reports [Online] // Boeing Investors. - 2017 g. - 05 17, 2017. - http://investors.boeing.com/investors/financial-reports/default.aspx.
16. **Brach Marion A.** Real options in practice [Article]. - [s.l.] : John Wiley & Sons, 2003. - Vol. 198.
17. **Bukhvalov Alexander V.** Master course "Risk Management". - [s.l.] : SPbU GSOM, 2016.
18. **Bulgarelli Francesca** Methods of Brand Valuation: A case study on Alibaba.com [Online] // HEC Paris. - June 2015. - 05 17, 2017. - http://www.vernimmen.com/ftp/Francesca_Bulgarelli_Master_Thesis.pdf.
19. **Business Jargons** Sales Force Composite Method [Online] // Business Jargons. - 2016. - 05 17, 2017. - http://businessjargons.com/sales-force-composite-method.html.
20. **Cheverton Peter** Understanding brands [Book]. - [s.l.] : Kogan Page Publishers, 2006. - Vol. 58.
21. **Damodaran Aswath** Data: Archives [Online] // Damodaran Online. - 2017. - 05 17, 2017. - http://pages.stern.nyu.edu/~adamodar/.
22. **De Chernatony Leslie** Creating powerful brands [Book]. - [s.l.] : Routledge, 2010.
23. **Deloitte** 2016 Global aerospace and defense sector outlook [Online] // Deloitte. - 2016. - 05 17, 2017. - https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Manufacturing/gx-manufacturing-2016-global-ad-sector-outlook.pdf.
24. **Dias Sam and Ryals Lynette** Options theory and options thinking in valuing returns on brand investments and brand extensions [Article] // Journal of Product & Brand Management. - 2002. - 11.2. - pp. 115-128.
25. **Dumrauf Guillermo López** Real options models [Online] // UCEMA. - 2015. - 05 17, 2017. - http://www.ucema.edu.ar/u/gl24/Slides/Real_options_models_ejercicios.pdf.
26. **Fontevecchia Agustino** Boeing Bleeding Cash As 787 Dreamliners Cost $200M But Sell For $116M, But Productivity Is Improving [Online] // Forbes. - May 21, 2013. - 05 17, 2017. - https://www.forbes.com/sites/afontevecchia/2013/05/21/boeing-bleeding-cash-as-787-dreamliners-cost-200m-but-sell-for-116m-but-productivity-is-improving/#108fd2c5cb53.
27. **Fripp Geoff** Benefits of the ATAR forecast model [Online] // ATAR Forecasts for Marketing. - 2016. - 05 17, 2017. - http://www.atar4marketing.com/atar-theory/benefits-of-the-atar-forecast-model/.

28. **Fripp Geoff** Limitations of ATAR forecasting [Online] // ATAR Forecasts for Marketing. - 2016. - 05 17, 2017. - http://www.atar4marketing.com/atar-theory/limitations-of-atar-forecasting/.
29. **Gartner William B. and Thomas Robert J.** Factors affecting new product forecasting accuracy in new firms Journal of product innovation management 10.1 (1993): 35-52. [Article] // Journal of product innovation management. - 1993. - 10.1.
30. **Giddens Nancy and Hofmann Amanda** Building Your Brand with Brand Line Extensions [Article] // AG Decision Maker. - [s.l.] : ISU Extension, June 2010 b.
31. **Giddens Nancy and Hofmann Amanda** Building Your Brand with Flanker Brands [Article] // AG Decision Maker. - [s.l.] : ISU Extension, June 2010 a.
32. **Green Kesten and Armstrong. J. Scott** Structured analogies for forecasting [Article] // International Journal of Forecasting. - 2007. - 23.3. - pp. 365-376..
33. **Gunelius Susan** Introduction to Brand Strategy – Part 1: What Is Brand Strategy? [Online] // AYTM. - 2013. - 05 17, 2017. - https://aytm.com/blog/research-junction/introduction-to-brand-strategy-part-1/.
34. **Gupta Seema** Branding and advertising [Book]. - [s.l.] : Global India Publications, 2009.
35. **Hennig-Thurau Thorsten, Houston Mark B. and Heitjans Torsten** Conceptualizing and measuring the monetary value of brand extensions: The case of motion pictures [Article] // Journal of Marketing. - 2009. - 73.6. - pp. 167-183.
36. **Hotten Russell** Boeing warns Airbus over reports of state aid [Online] // BBC news. - June 2015. - 05 17, 2017. - http://www.bbc.com/news/business-33165575.
37. **Investing.com** France 20-Year Bond Yield Overview [Online] // Investing.com. - 2017. - 05 17, 2017. - https://www.investing.com/rates-bonds/france-20-year-bond-yield.
38. **Kahn Kenneth B.** New-Product Forecasting [Book]. - [s.l.] : John Wiley & Sons, Ltd, 2010.
39. **Kapferer Jean-Noel** The new strategic brand management: Advanced insights and strategic thinking [Book]. - [s.l.] : Kogan page publishers, 2012.
40. **Keller David A.** Managing brand equity [Book]. - [s.l.] : Simon and Schuster, 2009.
41. **Keller Kevin Lane** The brand report card. [Article] // Harvard Business Review. - 2000. - Vol. 78.1.
42. **Keller Kevin Lane, Heckler Susan E. and Houston Michael J.** The effects of brand name suggestiveness on adver- tising recall [Article] // Journal of Marketing. - 1998. - Vol. 62 (1).

43. **Lazăr Cornel and Lazăr Mirela** Forecasting Methods of the Enrolled Students [Article] // International Journal of Applied Science and Engineering. - 2004. - 2.3. - pp. 234-244..
44. **Makridakis Spyros, Wheelwright Steven C. and Hyndman Rob J.** Forecasting Methods and Applications [Book]. - 1998. - Vol. 3.
45. **Mietzner Dana and Reger Guido** EU-US Seminar: New Technology Foresight, Forecasting and Assessment Methods [Conference] // Scenario Approaches: history, differences, advantages and disadvantages. - Seville : [s.n.], 2004.
46. **Mun Johnathan** Real Option Analysis [Book]. - Hoboken : John Wiley & Sons, 2006. - 2nd.
47. **Nasdaq** Crude Oil WTI Price [Online] // Nasdaq. - 2017. - 05 17, 2017. - http://www.nasdaq.com/markets/crude-oil.aspx?timeframe=9y.
48. **Piasecki Dave** Exponential Smoothing Explained [Online] // Inventory Operations Consulting. - 2012. - 05 17, 2017. - http://www.inventoryops.com/articles/exponential_smoothing.htm.
49. **Pitta Dennis A. and Katsanis Lea Prevel** Understanding brand equity for successful brand extension [Article] // Journal of Consumer Marketing. - 1995. - 4 : Vol. 12.
50. **Royo-Vela Marcelo and Voss Eileen** Downward Price-Based Brand Line Extensions Effects on Luxury Brands [Article] // Business & Economics Research Journal. - 2015. - 3 : Vol. 6. - pp. 145-161.
51. **Singh Mahender** New Product Forecasting [Online] // MIT Open Course Ware. - September 2006. - 05 17, 2017. - http://ocw.iti.im/courses/engineering-systems-division/esd-260j-logistics-systems-fall-2006/lecture-notes/lect5.pdf.
52. **Statista** The 15 countries with the highest military spending worldwide in 2015 (in billion U.S. dollars) [Online] // Statista. - 2015. - 05 17, 2017. - https://www.statista.com/statistics/262742/countries-with-the-highest-military-spending/.
53. **Sullivan Mary W.** How Brand Names Affect the Demand for Twin Automobiles [Article]. - May 1998. - No. 2 : Vol. Vol. 35.
54. **Tauber Edward** Brand Franchise Extension: New Product Benefits from Existing Brand Names [Article] // Business Horizons. - March 1981.
55. **Tolkachev Sergey** World market of civil aircraft production: end of duopoly [Online] // Kapital Strany. - September 2011. - 05 17, 2017. - http://kapital-rus.ru/articles/article/mirovoj_rynok_grazhdanskogo_aviastroeniya_konec_duopolii/.
56. **Trigeorgis Lenos** Real Options: Managerial Flexibility and Strategy in Resource Allocation [Book]. - [s.l.] : MIT press, 1996.

57. **University of Delhi** Sales Forecasting Methods [Online] // Virtual Learning Environment. - 2016. - 05 17, 2017. - http://vle.du.ac.in/mod/book/print.php?id=9217&chapterid=13390.
58. **Waseem Ahsan** Brand Management [Article]. - [s.l.] : Virtual University of Pakistan, January 2014.
59. **YCharts** 20 Year Treasury Rate [Online] // YCharts. - 2017. - 05 17, 2017. - https://ycharts.com/indicators/20_year_treasury_rate.

Appendices

Appendix 1. Airbus FCF valuation A350-900 (in EUR million)

	Airbus A350-900							Production													
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Historical demand	28	1	39	117	0	4	45															
Projected demand								22	22	22	21	21	21	21	21	19	21	20	19	22	24	23
Price							217	223	275	279	281	284	287	290	293	296	299	302	305	308	311	314
Discount							50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Discounted price								111	137	139	141	142	143	145	146	148	149	151	152	154	155	157
Production rate								4%	3%	4%	22%	15%	11%	8%	2%	6%	5%	7%	6%	2%	5%	2%
Production								23	16	24	119	85	59	42	9	34	26	38	31	9	27	12
Projected Rev								2593	2133	3364	16748	12135	8418	6127	1263	4974	3865	5725	4731	1327	4156	1896
Costs per 1 aircraft								89	110	111	113	114	115	116	117	118	119	121	122	123	124	126
Costs per production								2074	1707	2692	13398	9708	6735	4901	1010	3980	3092	4580	3785	1062	3325	1516
SGA								72	48	75	368	264	181	131	27	104	80	117	96	27	83	37
Profit before Tax								447	379	598	2982	2163	1503	1095	226	891	693	1028	850	239	749	342
Tax								110	93	147	733	532	369	269	56	219	170	253	209	59	184	84
Profit after Tax								337	286	451	2249	1631	1133	826	170	672	523	775	641	180	564	258

Source: the author's calculations

Appendix 2. Airbus FCF valuation A350-1000 (in EUR million)

	Airbus A350-1000										Production														
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Historical demand	37	46	0	61	0	0	43	0	0	24															
Projected demand											24	23	22	21	20	20	19	20	20	24	27	10	8	8	30
Price							250	257	317	322	325	328	331	335	338	341	345	348	352	355	359	362	366	370	373
Discount											50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Production rate											6%	9%	13%	14%	11%	16%	14%	3%	3%	2%	1%	3%	1%	2%	1%
Production											29	44	62	63	52	73	63	15	16	8	4	14	4	11	4
Projected Rev											4658	7144	10207	10486	8796	12510	10804	2589	2802	1509	762	2502	778	1963	793
Costs per 1 aircraft											130	131	133	134	135	137	138	139	141	142	144	145	146	148	149
Costs per production											3726	5715	8165	8389	7037	10008	8643	2071	2242	1207	610	2002	622	1571	635
SGA											89	134	190	194	161	226	194	46	49	26	13	43	13	33	13
Profit before Tax											843	1294	1851	1904	1599	2276	1967	472	511	276	139	458	142	360	146
Tax											207	318	455	468	393	560	484	116	126	68	34	113	35	88	36
Profit after Tax											636	976	1396	1436	1205	1716	1484	356	385	208	105	345	107	271	110

Source: the author's calculations

Appendix 3. Boeing FCF valuation 777-9 (in USD million)

	Boeing 777-9							Production													
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Historical demand	58	185	10	0																		
Projected demand					20	18	17	16	15	14	13	14	15	10	13	14	18	16	21	9	2	3
Price					400	400	400	400	402	404	406	408	410	412	414	416	418	420	423	425	427	429
Discount								49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%
Discounted price								204	205	206	207	208	209	210	211	212	213	214	216	217	218	219
Production rate								6%	9%	13%	14%	11%	16%	14%	3%	3%	2%	1%	3%	1%	2%	1%
Production								31	47	67	68	57	80	68	16	17	9	5	15	5	12	5
Projected Rev								6358	9703	13796	14104	11772	16659	14316	3414	3676	1970	990	3234	1000	2513	1010
Costs per 1 aircraft								160	161	162	162	163	164	165	166	167	167	168	169	170	171	172
Costs per production								4987	7611	10820	11062	9233	13066	11228	2678	2883	1545	777	2537	784	1971	792
SGA								108	165	233	237	197	277	237	56	60	32	16	52	16	40	16
Profit before Tax								1263	1928	2742	2805	2342	3316	2851	680	733	393	197	645	200	502	202
Tax								318	485	690	705	589	834	717	171	184	99	50	162	50	126	51
Profit after Tax								945	1443	2053	2100	1753	2482	2134	509	548	294	148	483	149	376	151

Source: the author's calculations

Appendix 4. Boeing FCF valuation 777-8 (in USD million)

	Boeing 777-8										Production														
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Historical demand	8	45	0	0																					
Projected demand					16	16	17	17	18	19	19	18	19	20	19	21	24	23	20	16	20	20	24	10	15
Price					371	373	375	377	378	380	380	382	384	386	388	390	392	394	396	398	400	402	404	406	408
Discount											49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%
Discounted price											194	195	196	197	198	199	200	201	202	203	204	205	206	207	208
Production rate											4%	3%	4%	22%	15%	11%	8%	2%	6%	5%	7%	6%	2%	5%	2%
Production											21	12	19	96	69	47	34	7	27	21	30	25	7	21	10
Projected Rev											4094	2431	3800	18822	13571	9368	6784	1391	5454	4216	6215	5110	1427	4444	2017
Costs per 1 aircraft											152	153	154	154	155	156	157	158	158	159	160	161	162	162	163
Costs per production											3211	1906	2980	14763	10644	7347	5321	1091	4277	3307	4874	4008	1119	3486	1582
SGA											73	43	68	333	239	164	118	24	94	72	106	87	24	75	34
Profit before Tax											810	481	752	3727	2688	1857	1345	276	1082	837	1234	1015	284	884	401
Tax											204	121	189	937	676	467	338	69	272	210	310	255	71	222	101
Profit after Tax											606	360	563	2790	2012	1390	1007	207	810	627	924	760	212	662	300

Source: the author's calculations

Appendix 5. ROA analysis for Airbus (in EUR)

A350-900 launch (option to abandon)	
So	7 075 540 764
K	8 800 000 000
u	2,15
d	0,47
Π	0,33
t	1,00
sigma annual	0,77
rf	0,016

Option to abando	2014	2015	2016
			32 709 354 388
		15 213 032 911	-
Asset Price	7 075 540 764	1 142 161 176	
Option Price	4 016 474 859		7 075 540 764
		3 290 815 014	1 724 459 236
		5 509 184 986	
			1 530 549 228
			7 269 450 772

A350-1000 launch (option to expand)	
So	6 401 879 666
K	2 200 000 000
u	2,55
d	0,39
Π	0,29
t	1,00
sigma annual	0,94
rf	0,016

Option to expand	2014	2015	2016	2017
				106 502 129 041
			41 719 717 787	104 302 129 041
		16 342 723 549	39 554 576 561	
Asset Price	6 401 879 666	14 211 888 762		16 342 723 549
Option Price	4 926 920 999		6 401 879 666	14 142 723 549
		2 507 786 609	4 236 738 440	
		1 265 920 112		2 507 786 609
			982 366 743	307 786 609
			87 516 105	
				384 819 192
				-

Investment	11 000 000 000
A350-900	80%
A350-1000	20%

Sequential option	2014	2015	2016
			39 554 576 561
		14 211 888 762	30 754 576 561
Asset Price		8 744 762 322	
Option Price	2 486 487 431		4 236 738 440
		1 265 920 112	-
		-	
			87 516 105
			-

Source: the author's calculations

Appendix 6. ROA analysis for Boeing (in USD)

777-9 launch (option to abandon)	
So	10 450 806 553
K	9 440 000 000
u	2,55
d	0,39
П	0,29
t	1,00
sigma annual	0,94
rf	0,025

Option to abandon	2017	2018	2019
			68 105 731 875
		26 678 827 354	-
Asset Price	10 450 806 553	-	
Option Price	3 731 988 920		10 450 806 553
		4 093 859 005	-
		5 407 872 378	
			1 603 673 503
			7 836 326 497

777-8 launch (option to expand)	
So	6 347 703 551
K	2 360 000 000
u	2,15
d	0,47
П	0,33
t	1,00
sigma annual	0,77
rf	0,025

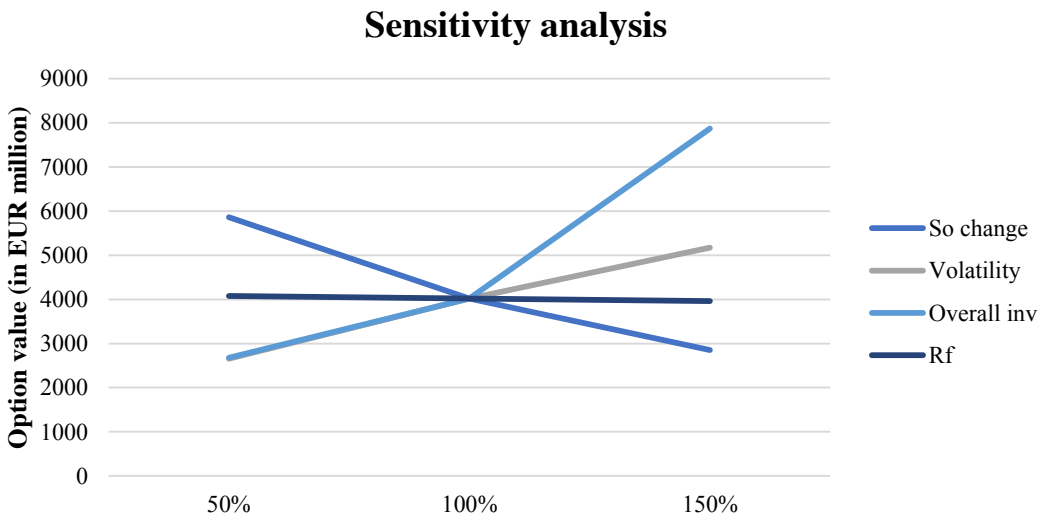
Option to expand	2017	2018	2019	2020
				63 093 575 348
			29 344 652 506	60 733 575 348
		13 648 119 099	27 041 449 492	
Asset Price	6 347 703 551	11 400 346 165		13 648 119 099
Option Price	4 630 782 314		6 347 703 551	11 288 119 099
		2 952 299 880	4 044 500 538	
		1 435 927 762		2 952 299 880
			1 373 106 748	592 299 880
			191 961 082	
				638 628 262
				-

Sequential option	2017	2018	2019
			27 041 449 492
		11 400 346 165	17 601 449 492
Asset Price		5 704 531 447	
Option Price	1 848 806 772		4 044 500 538
		1 435 927 762	-
		-	
			191 961 082
			-

Source: the author's calculations

Appendix 7. Airbus option to abandon sensitivity analysis (in EUR)

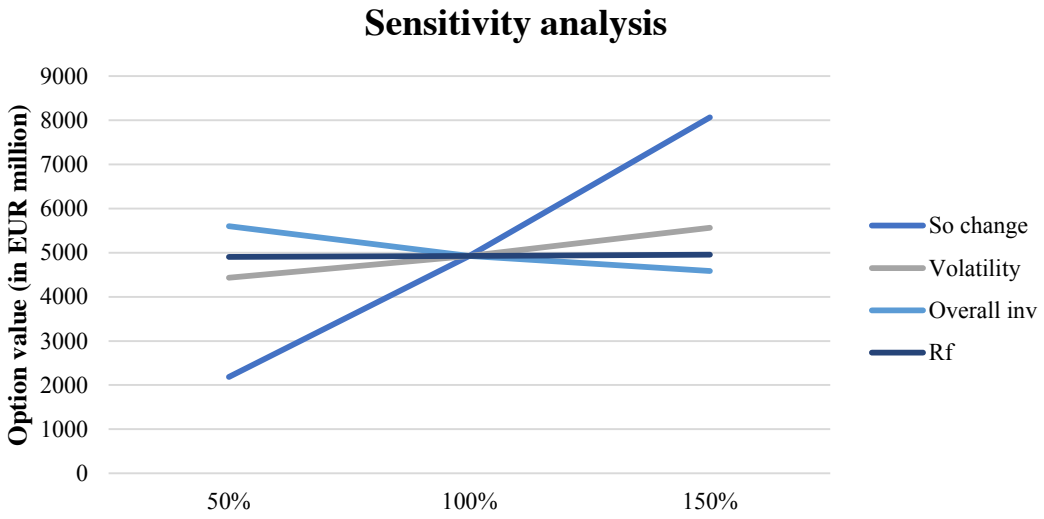
	Change in %		
	50%	100%	150%
PV FCFs	5 860 369 031	4 016 474 859	2 853 259 141
Volatility	2 653 735 398	4 016 474 859	5 171 786 234
Investments	2 675 540 764	4 016 474 859	7 868 606 461
Risk-free rate	4 074 774 067	4 016 474 859	3 959 018 863



Source: the author's calculations

Appendix 8. Airbus option to expand sensitivity analysis (in EUR)

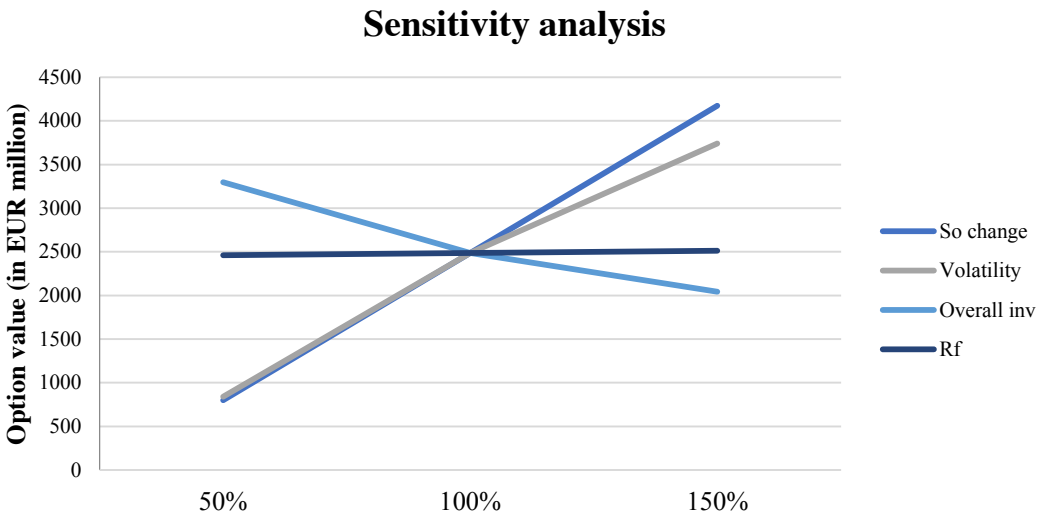
	Change in %		
	50%	100%	150%
PV FCFs	2 187 169 976	4 926 920 999	8 061 916 679
Volatility	4 433 628 045	4 926 920 999	5 559 620 584
Investments	5 598 456 180	4 926 920 999	4 586 340 152
Risk-free rate	4 901 367 724	4 926 920 999	4 951 930 497



Source: the author's calculations

Appendix 9. Airbus sequential option sensitivity analysis (in EUR)

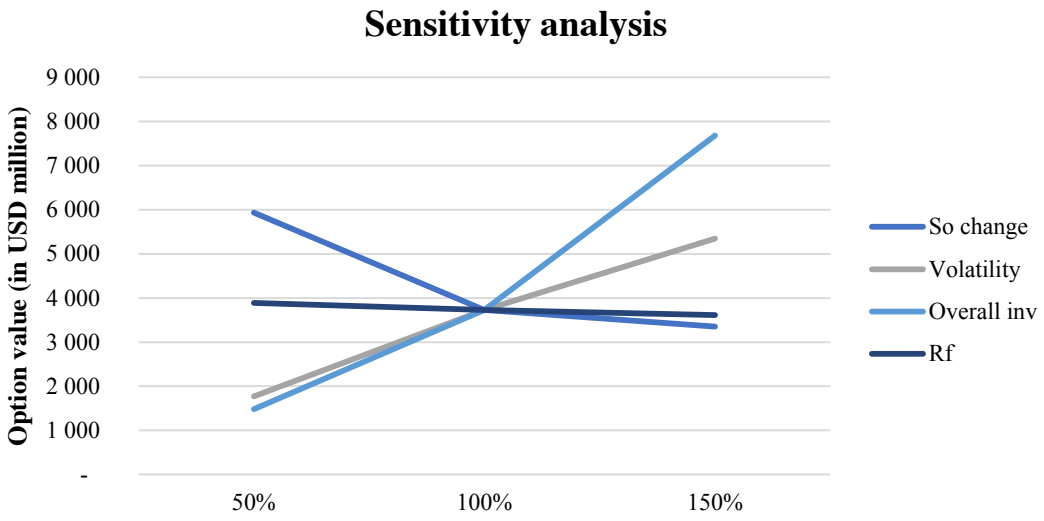
	Change in %		
	50%	100%	150%
PV FCFs	799 981 462	2 486 487 431	4 172 993 400
Volatility	839 686 489	2 486 487 431	3 742 134 389
Investments	3 295 608 042	2 486 487 431	2 043 225 177
Risk-free rate	2 460 250 466	2 486 487 431	2 512 461 201



Source: the author's calculations

Appendix 10. Boeing option to abandon sensitivity analysis (in USD)

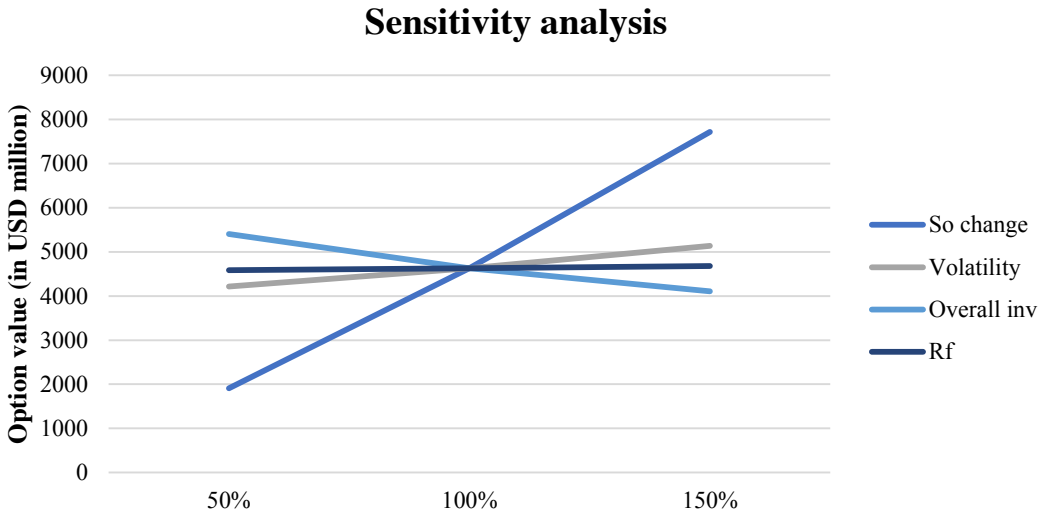
	Change in %		
	50%	100%	150%
PV FCFs	5 933 319 718	3 731 988 920	3 350 120 467
Volatility	1 770 557 017	3 731 988 920	5 347 401 853
Investments	1 484 126 007	3 731 988 920	7 678 321 625
Risk-free rate	3 885 401 431	3 731 988 920	3 616 106 064



Source: the author's calculations

Appendix 11. Boeing option to expand sensitivity analysis (in USD)

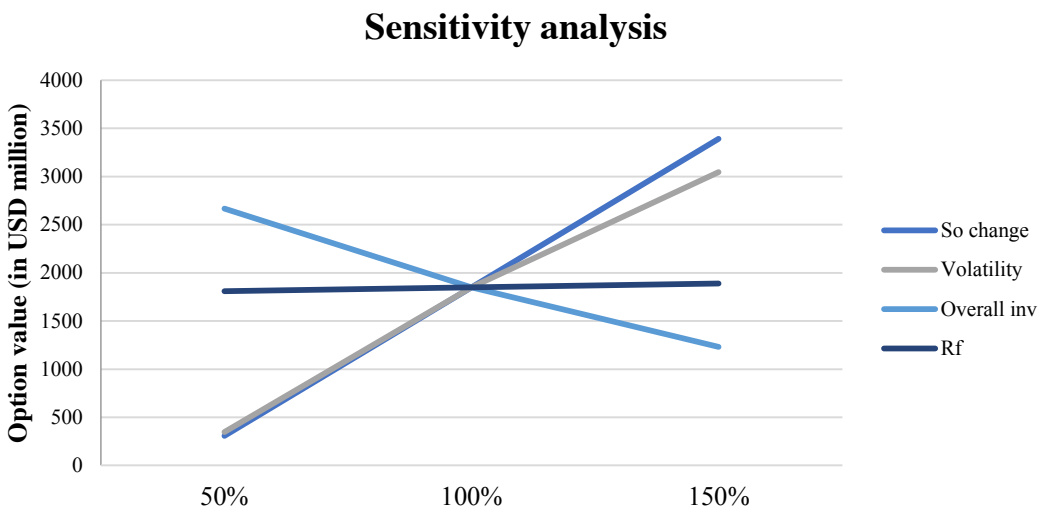
	Change in %		
	50%	100%	150%
PV FCFs	1 910 502 526	4 630 782 314	7 716 196 012
Volatility	4 211 547 452	4 630 782 314	5 137 553 944
Investments	5 400 804 855	4 630 782 314	4 103 548 966
Risk-free rate	4 583 707 727	4 630 782 314	4 676 348 103



Source: the author's calculations

Appendix 12. Boeing sequential option sensitivity analysis (in USD)

	Change in %		
	50%	100%	150%
PV FCFs	307 666 871	1 848 806 772	3 389 946 674
Volatility	346 327 495	1 848 806 772	3 044 645 054
Investments	2 666 703 448	1 848 806 772	1 232 070 257
Risk-free rate	1 808 675 790	1 848 806 772	1 888 464 058



Source: the author's calculations

Appendix 13. Airbus valuation (in EUR million)

Appendix 9.1. Assumptions of valuation

Assumptions	
EBI	30%
PPE growth	8%
CA growth	5%
Tax	25%
WACC	5%
g	3%

Appendix 9.2. Company's valuation (in EUR million)

	2016	2017	2018	2019	2020	2020	Terminal Value (TV)
EBI	1749	2274	2956	3843	4995	6494	
Current assets (CA)	54396	56939	59601	62388	65304	68357	
Working Capital (WC)	4494	2543	2662	2786	2917	3053	
Investment (WC)		-1951	119	124	130	136	
Property, plant & equipment (PPE)	46760	50363	54243	58422	62923	67771	
Investment (PPE)		3603	3880	4179	4501	4848	
FCF		622	-1043	-461	364	1510	1555
Present value (PV)	745						
PV TV	93578						
Value	75259						

Source: the author's calculations, Airbus (2017 f)

Appendix 14. Airbus WACC

WACC Calculation

Target Capital Structure	**2014**	**2016**
Debt-to-Total Capitalization	53,1%	60,1%
Equity-to-Total Capitalization	46,9%	39,9%
Cost of Debt		
Cost of Debt	5,9%	3,2%
Tax Rate	26,8%	24,6%
After-tax Cost of Debt	**2,7%**	**4,3%**
Cost of Equity		
Risk-free Rate	1,6%	1,3%
Market Risk Premium	5,7%	5,6%
Levered Beta	1,30	1,05
Cost of Equity	**8,9%**	**8,0%**
WACC	**6,4%**	**4,7%**

Source: Damodaran (2016), Investing.com (2017)

Appendix 15. Boeing Valuation (in USD million)

Appendix 11.1. Assumptions of valuation

Assumptions	
EBI	6%
PPE growth	4%
CA growth	8%
Tax	25%
WACC	8%
g	3%

Appendix 11.2. Company's valuation (in USD million)

	2016	2017	2018	2019	2020	2020	Terminal Value (TV)
EBI	5 125	6 406	6 801	7 220	7 666	8 139	
Current assets (CA)	66 617	71 959	77 730	83 964	90 697	97 971	
Working Capital (WC)	-5 331	5 342	5 771	6 234	6 734	7 274	
Investment (WC)		10 673	428	463	500	540	
Property, plant & equipment (PPE)	17 724	18 348	18 994	19 662	20 355	21 071	
Investment (PPE)		624	646	669	692	717	
FCF		-4 892	5 727	6 089	6 474	6 882	7 089
Present value (PV)	14645						
PV TV	141223						
Value	110672						

Source: the author's calculations, Boeing (2017 g)

Appendix 16. Boeing WACC

WACC Calculation	
Target Capital Structure	**2016**
Debt-to-Total Capitalization	59,4%
Equity-to-Total Capitalization	40,6%
Cost of Debt	
Cost of Debt	3,6%
Tax Rate	25,1%
After-tax Cost of Debt	**2,7%**
Cost of Equity	
Risk-free Rate	2,5%
Market Risk Premium	5,7%
Levered Beta	2,35
Cost of Equity	**15,8%**
WACC	**8,0%**

Source: Damodaran (2016), YCharts (2017)