Master´s Thesis

Strategic options of actions for pharmaceutical originators after core patent expiration

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Abstract

In view of high investments into research and development in the pharmaceutical industry, as well as difficulties to invent new medicines, the economic pressure on the pharmaceutical companies gets greater. At the same time, legal framework for the pharmaceutical industry gets more framed. These circumstances in combination with the fact that with the expiration of a patent protection the generics companies bring generics substitutes to the market and thus cause a tremendous drop in sales of branded drugs, forces companies-originators to look for methods to secure their revenues even after the core patent expiration. Such Life Cycle Management methods, which are used by pharmaceutical companies-originators to extend the patent life, are systemized and depicted in this master thesis. The assessment matrix, comprising market share, financial, and legal risk parameters is developed as a tool, which aims to serve management in evaluation of the strategic options of actions and to help with the choice of the most appropriate Life Cycle Management method for a given company and product.

Keywords

Pharmaceutical industry, patent, antitrust, Life Cycle Management, companies-originators, generics companies

JET: G70, I18, I19, L12, L41, O34, O38

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III List of abbreviations

ALCM Assessment of Life Cycle Management

BJR Business Judgement Rule

DCF Discounted Cash Flow

FDC Fixed Dose Combination

EU European Union

FrDC Free Dose Combination

LCM Life Cycle Management

LoE Loss of Exclusivity

MS Market Share

OD Orphan Drug

R&D Research and Development

SPC Supplementary Protection Certificate

1. Introduction

1.1 Research objective, relevance, and applicability

"The pharmaceutical industry is unique in its complexity" (Carrier & Shadowen, 2016, p. 205).

Objective

This master thesis aims to depict the methods applied by pharmaceutical companies-originators to safeguard the level of revenues after the core patent expiration and to derive an assessment matrix helping the management of the company to meet the choice of an appropriate and the most suitable method to apply.

Relevance and applicability

The motivation to research on the given topic is based on the fact, that pharmaceutical industry is a very complex one and with its value of around USD 1.48 trillion in 2022 is a considerable player in the world economy (Carrier & Shadowen, 2016, p. 205; Statista, 2023). Moreover, the field of possibilities of patent extension is still not researched well, as well as there is no systemized overview of methods existing. Also, the practical need exists in view of Business Judgement Rule (in the following "BJR") and linked with it increased legal responsibility of management in taking business decisions (Willen, 2019, p. 7). The ambition of this master thesis is to develop an assessment matrix supporting the decision-making process of management on the strategy to apply after the core patent expiration.

To answer the research question, the analysis of the legal framework on patenting within which the pharmaceutical companies operate, is performed in part two. The systematization and description of the applicable methods is done in part three. The guideline for the decision-making process, the assessment matrix, as well as an example of the application of the matrix, are depicted in the part four.

1.2 Methodology and way of investigation

Method

The concept of intersubjective comprehensibility, literature-based research and a criteria-based assessment tool are applied (Decker and Werner, 2016, pp. 16, 29). The

assessment tool has a form of a matrix, formulated on the basis of the *game theory*, i.e., containing the action alternatives, reflecting the knowledge of environment, and implying that the results of the decision should be measurable (Wessler, 2012, p. 2). In other words, a list of strategic options of actions with their relevant features is produced and the key characteristics of each feature in terms of legal risk, financial aspects and length of patent prolongation is depicted. The measurability is achieved by means of the calculation of the expected profit.

The matrix logics is based on the Laplace-rule, which assumes that in the uncertainty about the environmental parameters, the assumption of the equality of those parameters should be taken and that the decision would be based on the valuation of the total profitability, along with other non-financial parameters (Schütte, 2009, pp. 35 - 36). The financial parameter is defined through discounted cash flow, investment, and net present value. Non-financial parameters are legal aspect, company´s image, as well as the general strategy of the company.

Model

A reductive model is developed (Decker and Werner, 2016, p. 16).

Way of investigation

To fulfil the purpose of this master thesis, the literature-based research is conducted. First, the patent law with the most important milestones in the development of the current patent legislation is examined. Secondly, the real timeframe of monopoly versus the patent time is explained. In the third part the methods for prolongation of the patent life are depicted. In the fourth part a reductive model in the form of the assessment matrix and graphs guiding through the decision-making process are developed.

2. Legal and economic framework

2.1 Patenting in pharmaceutical industry

A patent and its use

“Patente werden nach §1 Abs. 1 Patentgesetz (PatG) für Erfindungen auf allen Gebieten der Technik erteilt, sofern sie neu sind, auf einer erfinderischen Tätigkeit beruhen und gewerblich anwendbar sind“ (Kraßer & Ann, 2016, p.1). “A patent, in

simple terms, is a temporary monopoly right granted by the government to the inventor for an invention" (Dwivedi et al., 2010, p. 324).

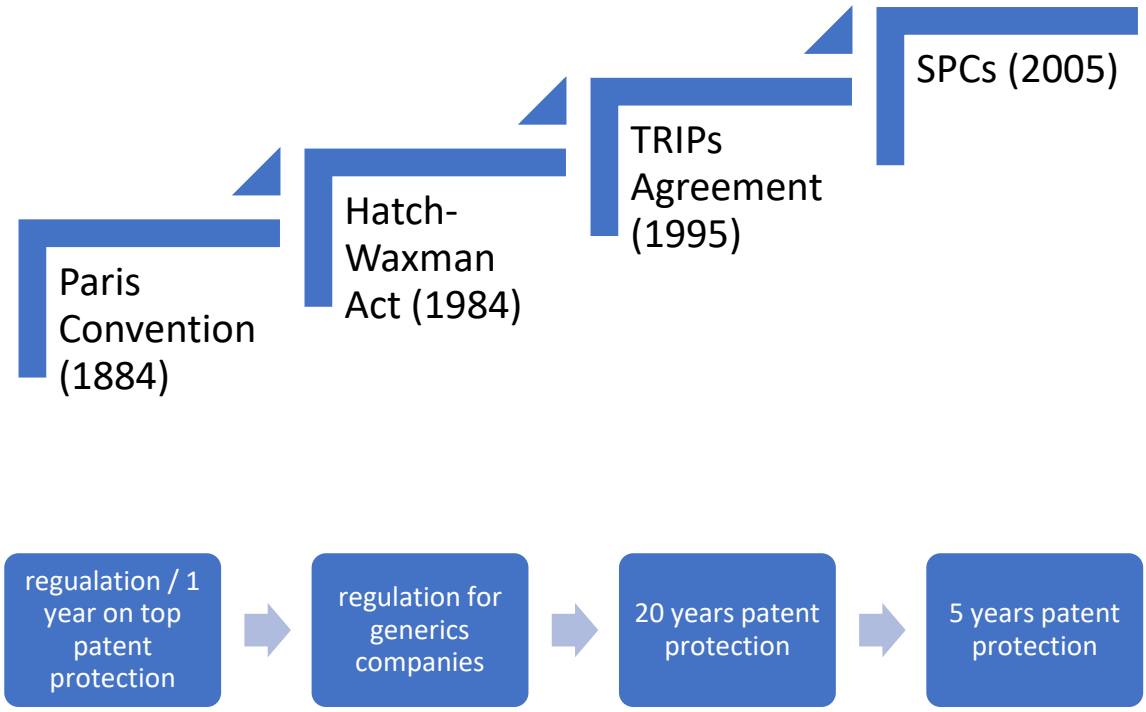
"The basic function of a patent as originally intended by the architects of the patent system is to provide an effective instrument to prevent imitation by competitors, in order to secure earnings from innovative technologies for the inventor and cover his expenses" (Blind et al., 2008, p.3).

"Patent is a form of insurance policy for inventors, including research-based pharmaceutical companies" (Bansal et al., 2009, p. 301).

The question whether to patent an invention or not is treated in various industries differently. "A patent is a property right issued by a government authority allowing the holder exclusive rights to the invention for a certain period of time" (Kurt, 2022, Investopedia). „The pharmaceutical industry is one in which the economic rationale for patents works to protect inventors from imitations and provides incentives to bear the cost of innovation" (Hyewon, 2014, p. 93). Through patent a company gets a legal monopoly (Roox, 2008, p. 5). Though various industries however do not use patents, the pharmaceutical industry is the exception among the variety of industries. Here the patent protection is of tremendous importance and is always used (Cohen et al., 2000, pp. 1, 2; Levin et al., 1988, p. 798). The market monopoly, which patent gives, allows pharmaceutical companies to secure high profits and return on investment (Bhat, 2005, p. 109; Gupta, 2010, p. 3). At the same time due to the question of social fairness of patents, the framework on patenting has been being under constant development (Levin et al., 1988, p. 786).

Thus, there are four important milestones which form the present patenting in the pharmaceutical market. These milestones can be subdivided into two categories: those which define the procedural regulations (Paris Convention and Hatch-Waxman Act) and those which define the lifetime of a patent (Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Supplementary Protection Certificates (SPCs)).

Figure 1 Milestones of legal framework on patenting in pharmaceutical industry



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Hatch-Waxman Act (1984)

One of the key elements of the patent framework is the Drug Price Competition and Patent Term Restoration Act, also named Hatch-Waxman Act, proclaimed in 1984. The Act reassures Research and Development (R&D) in pharmaceutical industry, as well as enables market entrance for generics drugs (Pace & Adam, 2018, p. 24; Drake et al., 2014, p. 3; Bhat, 2005, p. 111; Grabowski et al., 2017, p. 35). Cook (2011) writes, that the Hatch-Waxman Act represents "compromises reached in negotiations between the brand name drug industry and the generic drug industry" to "assure [ ] consumers of more low-cost generic drugs when a valid patent expires and the drug industry of sufficient incentive to develop innovative pharmaceutical therapies" (pp. 424 – 425). According to Paragraph IV of the Act the generics companies are motivated to challenge the legitimacy of the patent of pharmaceutical original products. According to the Act, the generics company which succeeds in demonstrating that the patent is invalid and thus that it has the right to enter the market, is given then a unique right to be active on the market for 180 days. Only after expiration of those 180 days other generics companies would be allowed to enter the market (Reiffen and Ward, 2007, p. 262).

TRIPS (1995)

Another important milestone in the development of patent rights is the proclamation of Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement in 1995 (Matthews, 2003, p.7). According to World Trade Organization´s Agreement of Trade Related Aspects of Intellectual Property Rights (TRIPS) the patent life is defined to be 20 years (Lawson, 2013, p. 379).

Paris Convention (1884)

The Paris convention, proclaimed in 1884, allows to extend the period of 20 years by one year by means of using the registration procedure of a patent. Paris convention permits a company to use one year of time after filing a patent in one member state which signed the Paris convention, to file it in other member states (Bhat, 2005, p. 113). In other words, according to the Paris Convention the company applying for a patent in one member state is given one year to file the patents in all other member states (see appendix A for information on member states). In such a way an additional year of patent protection can be gained before the core patent starts to be valid (Bhat, 2005, p. 113).

Supplementary Protection Certificates (SPCs) (2009)

Another five years of patent protection can be granted after the core patent expiration by Supplementary Protection Certificates (in the following “SPCs”) in Europe. “SPCs are not strictly patent term extensions, but rather separate (or sui generis) rights that come into effect upon expiry of a patent for a maximum period of five years” (European Patent Academy, 2015, p. 61).

To get an SPC, an application must be submitted to the office which authorized the basic patent, while the basic patent is still valid and if no other SPC has been obtained earlier (European Patent Academy, 2015, pp. 64, 66).

2.2 The real timeframe of monopoly

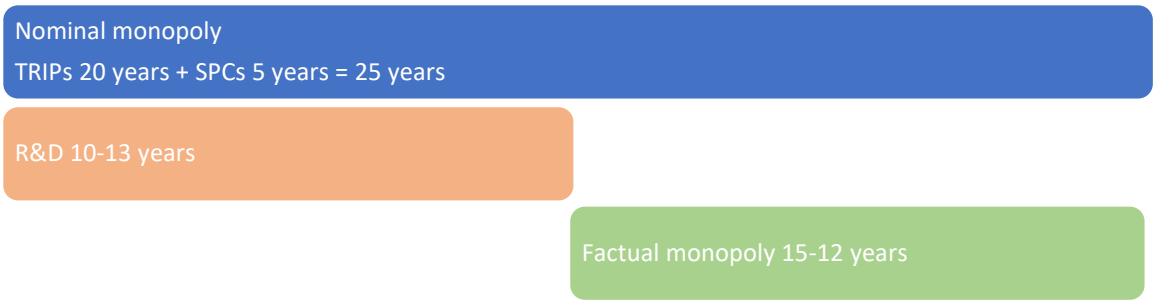
To be motivated to conduct research and development, a pharmaceutical company needs to see that the prognosed returns are high enough to worthy the investment (Levin et al., 1988, p. 783; Hyewon, 2014, p. 22).

The Research and Development (in the following “R & D”) process takes around 10 – 13 years. Because of the time difference between patenting and commercialization of a drug, the timeframe of effective monopoly through core patent is smaller than timeframe of nominal monopoly of 20 years (Hu et al., 2022, p. 1). Whereas the cost of development and testing of a new drug according to the research conducted in 2009 has taken at that time in average USD 800 mln, the research of 2015 indicates the cost of a new drug development at around USD 2,56 bln (Hyewon, 2014, p. 61; Enright and Dalton, 2014, p. 92; Bansal et al., 2009, p. 301; Kakkar, 2015, p. 1353).

SPCs are the result of acknowledgement of the fact that despite 20 years of core patent term, the effective exploitation of the patent protection in pharmaceutical industry is around 10 - 7 years, which puts the pharmaceutical industry under pressure in view of the investment volumes into R&D of a new drug (European Patent Academy, 2015, p. 59). Thus, with the help of SPCs the effective monopoly is increased up to 15 – 12 years.

Despite the fact, that when applying all patent extensions without Life Cycle Management methods, a drug can get a patent protection up to 25 - 26 years, this time frame is diminished by the time needed to accomplish R&D process and to fulfil all legal requirements to be allowed to market the medicine. Thus, a pharmaceutical company has factually around 15 - 12 years to benefit from the patent.

Figure 2: Factual monopoly timeframe



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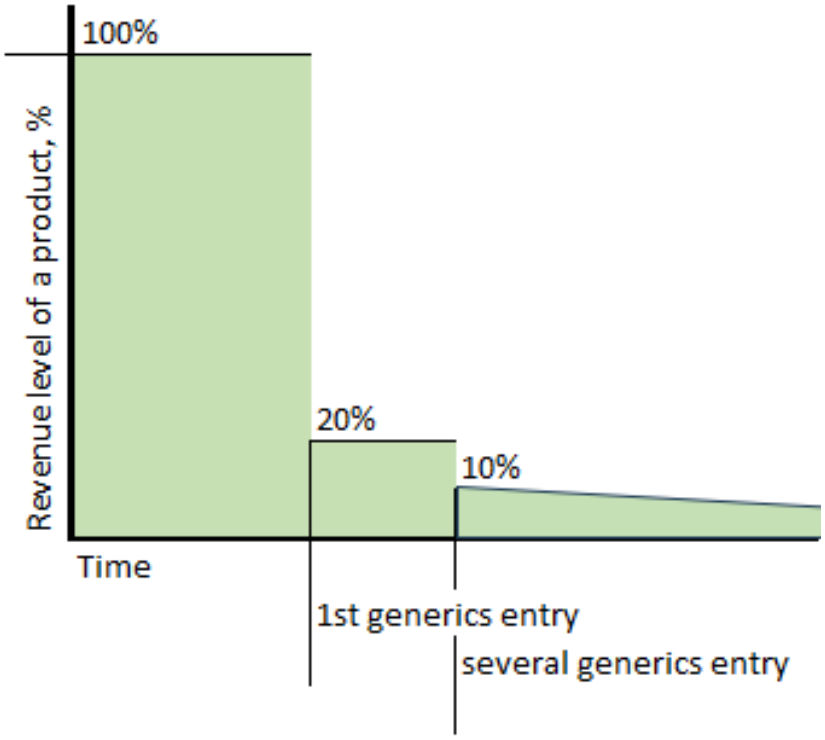
2.3 Companies-originators and generics competition: the influence of generics competition on the revenues of the company-originator

The pharmaceutical market has various stakeholders. Two of them are the companies-originators and generics companies. Companies-originators are those which by means of research discover new medicine, patent it, give it a brand name and market it. The generics companies are those, which copy the formula of the patented medicine and after patent expiration sell it under a different name to a much lower price than the original brand (Dukes, 2006, pp. 11-12). Generics have the same bioequivalence profile as the original drugs and fulfill all quality requirements, but they are less costly due to absence of R&D cost (Danzon, 2014, p. 9).

The expiration of patent protection, also named loss of exclusivity (LoE), and the consecutive entrance of generics means for an originator company both a loss of market share, and a tremendous drop in its revenue (Creyer et al., 2001, p. 52; Raasch, 2010, p. 53; Gupta, 2010, p. 2; Kakkar, 2015, p. 1353; Rikkala, 2020, p. 1). As soon as loss of exclusivity happens, the generics enter the market and a “hyper-competition on the price dimension” starts (Philipp, 2010, p. 39).

The research shows that after the first generics enters, the branded product loses around 80% of the revenue. At the time when several generics enter the market, the loss is even higher – around 90% (Gorgula, 2020, p. 1066; Feldmann, 2007, p. 601).

Figure 3: Revenue drop after generics enter the market



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Such examples of drop in revenue can be also accompanies by the drop of market share. So, the patent expiration of Zantac (GlaxoSmithKline) was followed by the drop in its market share by more than 3 times within a half of a year; the expiration of the patent of Capoten (GlaxoSmithKline) resulted in sales drop by 83% withing a year after the generics appeared on the market. The generics enter the pharmaceutical market with a price level which is 70 – 90% lower than the original product price. This motivates the consumers to switch to a cheaper variant of the medicine with the same bioequivalence profile. In the USA, for example, when coming into the market, the generics take over up to 90% of market share from the company-originator (Danzon, 2014, p. 11). Therefore, pharmaceutical companies-originators are interested in delaying the entry of generics by as much time as they can. In the case of blockbuster-drugs (i.e. drugs whose level of revenues reach a billion of euros p.a.) each month of a delay can result in safeguarding of millions of euros (Feldman, 2018, p. 601). At the same time for some drugs the level of research & development (R&D) investment is so high, that the pharmaceutical companies face a problem that the period of the patent

protection may be not sufficient to get the investments into R&D back (Philipp, 2010, p. 39). For example, the average R&D cost per compound development was estimated in 2015 at the level of around USD 1.4 bln (Boscheck, 2015, p. 224).

These facts in combination with the difficulty to fill in the pipeline with new drugs causes strong incentives for pharmaceutical companies to find a way to safeguard their factual monopoly on sales of their products (Gupta, 2010, p. 2; Bhat, 2005, pp. 117 - 118).

2.4 Legal framework of antitrust law

The companies look for ways to safeguard their sales and market share and develop strategies helping them when the patent expires. At the same time on the other side the law supervises that the interest of a company does not outweigh the interest of community by harming the antitrust law. According to 1890 Sherman Act the monopolization is illegal. Monopolization is a conduct by a firm that "unreasonably restrains competition by creating or maintaining monopoly power" (Danzon, 2014, p. 23). The 1914 Federal Trade Commission Act prohibits unfair and deceptive practices in competition. The Clayton Act of 1914 in combination with the Robinson Patman Act of 1936, forbids usage of discriminatory pricing or other discriminatory deals between companies (Danzon, 2014, p. 23).

3. Strategic options of actions after core patent expiration

3.1 Life Cycle Management as a means of mitigation of patent expiration

"Systematische Konzepte verpflichten Manager geradezu, sich intensiv und systematisch mit der Zukunft zu beschäftigen und Analysen über den Tag hinaus anzustellen" (Eschenbach et al., 2008, p. 1).

Life Cycle Management definition

Due to the reasons illustrated before, the pharmaceutical companies look for ways to prolong their monopoly after the core patent expiration. The strategies enabling such kind of monopoly extension are called "Life Cycle Management" strategies. Other known names are "evergreening", "line extension", as well as "product reformulation"

(Hyewon, 2014, p. 89; Kakkar, 2015, p. 1357). In this paper the terminus “Life Cycle Management” (in the following “LCM”) is used.

LCM purpose

LCM helps to increase total value of drugs by prolonging their product life, and hence is of high importance for originator pharmaceutical companies (Daidoji et al., 2014, p. 172; Seki et al., 2022, p. 1). “Product Lifecycle Management (PLM) improves the processes of a company’s product development and provides an ability to use product-related information to make better business decisions” (Mousavi et al., 2022, p. 1).

According to statistics given by Feldman (2018), in the period between 2005 and 2015, between 78% and 80% of new patents given by FDA, concerned the modifications of existing drugs and not patenting of the new ones (pp. 617-618).

3.2 Life Cycle Management methods, their characteristics, and examples of use by pharmaceutical companies

This part presents the schematic overview of the LCM methods and describes them in detail, naming their key characteristics and describing the legal and financial aspects of use.

The following overview summarizes and depicts the LCM methods identified by means of literature-based research.

Table 1: Overview of the LCM methods

			Key Parameters		
Nr	LCM Methods	Description	Possible Prolongation	Legality	Financial Aspect
1	Divestiture	Reduction / stop of promotion spendings	No prolongation	Legal	Getting the price for selling the know-how
2	Second generation drugs	Improved variant of drug	6.5-7.5 years	Legal	Saving revenue through patent
3	Product hopping	Replacement of the product by a similar one / change of formula	4 years	Soft form: legal; Hard form: illegal	Soft: 30% of revenue remain; Hard: 80%/100% of revenue remain
4	New uses & new treatment	Research of new fields of application	7.4 years / orphan drugs 7 years	Legal	Saving revenue through patent
5	New delivery & new dosage	Research on change of delivery method/ dosage	3 years	The recognition of legality depends on the court	In case of recongnition of legality, saving revenue through patent
6	Combination of known drugs into one product	Fixed dose combination: mix of tablets into one; Free dose combination: separate tablets combination	5 years	Legal	Saving of revenue through patent or possible increase of revenue
7	Introduction of own generics	Launch of own generics parallel to branded drug	No prolongation	Legal	Sales rent higher by 3.2% vs if not to launch the own one
8	Strategic patenting	Patenting of processes along with compounds	The longest prolongation, can achieve 15 years	Legal	Saving revenue through patent
9	Harvesting strategy	Bases on brand loyalty: customers remain even after generics entry	No prolongation	Legal	Short-term strategy, skimming of revenues
10	Switch to over-the-counter form	Change of the prescription form, can be accompanied by adjustment of price	No prolongation	Legal	Safeguarding or maximizing revenues through the increase of the sales volume
11	Pay-for-delay	Payment to a generics company for coming later into the market	No patent prolongation, but guarding the market monopoly in average 17 months, can get to several years	Questionable in the light of competition law, depends on the "rule-of-reason" analysis	Safeguarding of revenues as long as safeguarding of the monopoly
12	Licensing /cross-licensing	Licensing out of patent rights	No prolongation	Legal	Royalties or one-off payment
13	Strategic pricing	Price decrease	No prolongation	Legal	Contribution margin is guarded through sales volume

Source: own Table

3.2.1 Divestiture, divestment

Table 2: Key characteristics of divestiture method

Description	Reduction / stop of promotion spendings
Legality	Legal
Financial aspect	Getting the price for selling the know-how
Possible prolongation	No prolongation

Source: own Table

Description

The *divestiture* or *divestment* strategy entails reduction or complete stop of financing of the promotion of the product to better the contribution margin of the product as soon as generics enter the market (Chandon, 2004, pp. 65-66). The strategy is applied as

soon as the profit decline is anticipated (Barney & Hesterly, 2012, p. 58). The objective of the *divestment* strategy is to stop to operate in a business which declines. A company sells the know-how and related documents and passes over the related supplier contracts to a different company. Thus, the company abandons the selling by itself of the medicine whose patents are about to expire, sells those patents and uses the gained capital (Barney & Hesterly, 2012, pp. 58-59).

Legal considerations

The strategy is legal as long as it conforms to BJR, "wonach eine verantwortungsbewusste, unternehmerische Handlung auf Grundlage sorgfältiger Abwägungen benötigt wird" (Willen, 2019, p. 7).

Financial aspects

The *divestment* strategy gives a one-off revenue, the sum agreed in the sales agreement. At the same time no additional investment is needed (Barney & Hesterly, 2012, pp. 58-59).

3.2.2 Innovation, second generation drugs

Table 3: Key characteristics of second generation drugs method

Description	Improved formula of the original product
Legality	Legal
Financial aspect	Saving revenues through patent. Cost: 10 – 50 Mln USD (state of knowledge in 2005)
Possible prolongation	6.3 – 7.5 years

Source: own Table

Description

One of the possibilities to extend the market monopoly and accordingly to contain the level of revenues is to further invest into R&D, working on improvement for the existing medicine, also called the first generation drug. When successful, as soon as the patent of the first generation drug expires, the company launches the *second generation* drug (i.e. the improved kind of the first generation drug). To get the *second generation* drug

patented, higher efficacy of the new formulation or other advantages for the patient should be proved. The patents for second generation drugs are called second generation patents and prolong the factual monopoly of a company by 6.3 – 7.5 years (Kakkar, 2015, p. 1357; Chandon, 2004, p. 65; Gupta et al., 2010, p. 4; Daidoji et al., 2014, p. 178; Moir, 2016, p.414; Siddalingaiah & Fugh-Berman, 2022, p. 1120).

According to Daidoji et al. (2014) this strategy is the mostly used one in the USA (p. 172). Using the internal company knowledge of the R&D department, one can decide whether the drug has a potential to be bettered in a way that it would be entitled for a secondary patent (Ndlovu, 2015, pp. 787, 790).

The superiority of *second generation* drugs towards the first generation drugs can be reached by means of, for example, improvement of side-effects profile, improvement of efficacy. Such success stories are Monopril, which substituted Capoten (Bristol-Myers Squibb), Ceclor and Lorabid as a successor of Keflex of Eli Lilly (Bhat, 2005, p. 118).

Legal considerations

The extension of the patent by means of bringing of a *second generation* drug with a proved bettering of the product is legal and there is no risk of losing a litigation even if a generics company would try to start a lawsuit on validity of the patent (Gupta et al., 2010, p. 4).

Financial aspects

According to the research done by Bhat (2005), the cost of introduction of second generation drug is estimated to be in the range “between USD 10 million to USD 50 million“ (p. 118). Thus, the R&D investment is substantial. However, when considering a high chance of patentability, it has a big chance to be outweighed by revenues.

3.2.3 Product hopping

Table 4: Key characteristics of product hopping method

Description	Replacement of the formulation
Legality	Soft form is regarded as legal, Hard form can be regarded as illegal
Financial aspect	Soft form: around 30% of revenue is guarded, Hard form: around 80-100% of revenue is guarded
Possible prolongation	4 years

Source: own Table

Description

Product hopping is a method which is linked to a discontinuation of the old formulation and replacement of it by a new one. However, the change does not necessarily bring additional benefits in its features (Pace & Adam, 2018, p. 24; Danzon, 2014, p. 33; Carrier & Shadowen, 2016, p. 171; Siddalingaiah & Fugh-Berman, 2022, p. 1120).

There are two forms of *product hopping*: the *soft* one and the *hard* one. In the case of the *soft* form, the modified medicine is launched without a withdrawal of the original product from the market, thus it poses a possible alternative without forcing the consumer to an immediate switch. In the *hard* form of product hopping the original version is withdrawn from the market and thus the consumers are forced to buy a new version, as the original one is not available anymore (Carrier & Shadowen, 2016, p. 171).

This method forces the generics companies to re-engineer the product and gives additional 4 years of factual monopoly to a medicine (Siddalingaiah & Fugh-Berman, 2022, p. 1120; Carrier & Shadowen, 2016, p. 207).

Legal considerations

The extension of the patent by means of product hopping with regards to the legality is not straightforward and bears the risk of litigation. The generics company can try to start a litigation regarding the validity of the patent. Here it is important to distinguish between *soft* product *hopping* and *hard* product *hopping*.

Carrier and Shadowen (2016) indicate two possibilities allowing the companies to conduct product hopping without getting into a risk to face a litigation (p. 177). The first possibility is the execution of the hopping at latest 18 months before the patent expiration. This would be well in advance before the generics entry into the market and would “be immune from antitrust scrutiny” (Carrier & Shadowen, 2016, p. 207). The second safe possibility is when the product *hopping* happens after the generics have already entered the market (Carrier & Shadowen, 2016, p. 177).

However, the risk of litigation is high if a new product is launched at the same time with a complete withdrawal of the original one. An example of such a scenario is the case of Schneiderman vs Actavis PLC (drug Nameda), in which the court found the product hopping illegal with the following justification: “when a monopolist combines product withdrawal with some other conduct, the overall effect of which is to coerce consumers rather than persuade them on the merits and to impede competition, its actions are anticompetitive under the Sherman Act” (Carrier & Shadowen, 2016, pp. 198-199). As a result, the court decided that Actavis PLS had to bring back the original form of tablets and make it available for a consumer, so that the consumer has a choice which form to buy (Carrier & Shadowen, 2016, pp. 199-200).

An example of a litigation case is the product hopping performed by Astra Zeneca. As the patent of one of Astra Zeneca´s drugs – Prilosec – expired, it was withdrawn from the market and exchanged by its modified variant named Nexium. Such product hopping resulted in a lawsuit filed by generics companies against Astra Zeneca in 2006 (Lehnhausen, 2017, p. 50).

Financial aspects

The financial aspect when deciding between the soft switch and the hard switch is directly linked to the possibility to safeguard the market share. Within the soft switch, it is expected that 30% of patients could be guarded. Within the hard switch it is expected to guard from 80% to 100% of patients (Carrier & Shadowen, 2016, pp. 199-200).

Pharmaceutical companies may tend to take the risk of possible litigation if the promised revenue is high enough to leverage the risk. To take such a decision, the calculation of forecasted revenues in case of the product hopping execution is done.

Thus, in the case of TriCor (AbbVie Inc.) – the cholesterol medication – the forecast indicated the 10-fold increase of sales if hopping would be performed. Thus, the decision was taken by AbbVie Inc to conduct the product hopping. Another important aspect is that product hopping helps a company to guard the market share (Carrier & Shadowen, 2016, p. 177).

3.2.4 Patenting of new uses and new treatment indications

Table 5: Key characteristics of patenting of new uses and new treatment indications method

Description	Investigation on additional areas for treatment
Legality	Legal
Financial aspect	Possibility to safeguard or increase the revenue
Possible prolongation	7,4 years

Source: own Table

Description

While having the patented product on the market, a company may further maintain the research for further areas of application of molecule. In such a way new areas of treatment can be found, and an additional patent protection can be achieved. “A ‘new use’ enables a company to further patent, rebrand and remarket one drug for multiple indications” (Siddalingaiah & Fugh-Berman, 2022, p. 1120). Patenting of new uses gives additional 7,4 years of patent protection (Siddalingaiah & Fugh-Berman, 2022, p. 1120).

An example of such method is the use of ingredient Finasteride of the drug Proscar (MSD) initially patented to treat prostate. After further research it was found out that Finasteride can be used for treatment of baldness. Finasteride was then filed as a medicine to cure baldness under the brand name Propecia (Gupta et al., 2010, p. 5).

Another example is Atomoxetine patented initially by Lilly as a drug treating depression and secondly patented under brand name Strattera to treat hyperactivity disorder (Gupta et al., 2010, p. 5). Valium (with ingredient Diazepam) is another remarkable example. It was patented in 1963 with indications of being a drug helping patients

having anxiety symptoms. In 1974 the list contained 18 indications for Valium, like gastrointestinal disorders, surgery, anesthesia, asthma, and others (Bhat, 2005, p. 115).

Pediatric use

Separately should be highlighted, that each medicine which gets approved for pediatric area gets additional 6 months of patent protection. In such a way it is intended that the companies also investigate their products for possibility of pediatric use. Pfizer extended the field of application for Lipitor (cholesterol medicine) into pediatric area, receiving 6 additional months of patent protection for the whole palette of Lipitor (Ku, 2015, p. 599).

Orphan drugs

An important area in which the patenting of new uses is broadly applied is orphan drugs (Seki, 2022, pp. 1, 9). *Orphan drugs* are medicines treating seldom illnesses (Bundesinstitut für Arzneimittel und Medizinprodukte, 2023). When a medicine is classified as *orphan drug (in the following "OD")*, the prolongation of the patent protection is guaranteed and its length is 7 years (Feldman, 2018, p. 624). A beneficial fact here from the point of view of LCM is that the drug does not have to be redeveloped. As soon as the drug receives a qualification as an OD, the additional patent protection can be applied for (Feldman, 2018, p. 625).

Legal considerations

This method is legal and does not bear any risk of litigation.

Financial aspects

The financial advantage is linked to the fact that under the prolonged patent protection the company does not experience revenue fall or loss. Moreover, if the drug can be classified as an OD, the company may even increase its price and thus increase its profit respectively. According to Feldman (2018), a yearly revenue per one patient using OD may reach around 100.000 USD (pp. 624-625). Companies may go even beyond the patient groups to which the ODs are dedicated and apply the price to a wider patient population, using in such a way "spillover pricing". An example of such practice is the prescription of the medicine Epogen (Amgen Inc), used for treatment of

renal anemia in end stage and thus being OD. After Epogen was classified as OD, it was also used in treatment of other kinds of anemia and thus was used for a wider patient population (Feldman, 2018, pp. 624-625).

3.2.5 New delivery and new dosage of drugs

Table 6: Key characteristics of new delivery and new dosage method

Description	Change of delivery method of a drug
Legality	Legal, but no guarantee of patent prolongation
Financial aspect	Investment into changing of delivery method and possible litigation fees need to be lower than prognosed revenues
Possible prolongation	3 years

Source: own Table

Description

The most frequent form of drugs is the form of pills. This is due to the "relatively lower developmental challenges, short development time, scalability and high user acceptance" (Dubey & Dubey, 2009, p. 108). Nevertheless, these very facts at the same time make it easy for generics companies to bring the generics form to the market (Dubey & Dubey, 2009, p. 108). Non-oral formulations have a considerable advantage against the oral formulations when it comes to competition with generics. This is because the approval of non-oral pharmaceuticals demands some more clinical trials to be conducted than it is the case with oral pharmaceuticals (Daidoji et al., 2014, p. 177).

To guard the position in the market facing the patent expiration, a company can provide a *new delivery* method of a drug. Thus, an additional patent can be obtained for three years. However, the patent would be given only in case if additional clinical research is done (Bhat, 2005, p. 116).

According to Bhat (2005), around 13% of drugs around the world incorporate the *new delivery* method (p. 119). One of the ways used in pharmaceutical industry for incorporation of the *new delivery* method is by means of collaboration with a drug

delivery company (Bhat, 2005, p. 119). An example of application of *new delivery* method strategy is the change of formulation of Imitrex (Sumatriptan) (GlaxoSmithKline [GSK]) into intranasal delivery treatment (Gupta et al., 2010, p. 4).

Legal considerations

The LCM method of *new formulations* does not guarantee that in case of litigation a patent extension would be confirmed. The acknowledgement of its legality depends on the decision of the court. However, it might help to win several years of sales by means of making obstacles to generics companies in bringing generics into the market. Below named cases are examples of application of *new delivery method* in pharmaceutical industry.

TriCor (Abbott) – a drug used to lower cholesterol and sold in the form of capsules – was going to lose its patent protection in the beginning of 2000s. Teva Pharmaceuticals Inc. wanted to bring generics of TriCor to the market. Facing the threat of generics entry, Abbott changed the form of TriCor to tablets. At that time Teva had a generics approval for the capsules, but not for tablets. Since Abbott withdrew capsules from the market and started to commercialize the medicine in the form of tablets, the consumers were forced to switch to tables and Teva was forced to adjust its generics version to a tablets form. After that, Abbott changed the form one more time. This ended up in litigation between Teva and Abbott, in which Abbott was found guilty in abusing its monopoly position and thus violating the antitrust law. The decision of the court was based on the argumentation that consumer had no chance to choose between the old and the new version of the medication (Lehnhausen, 2017, p. 51).

Another example is Viagra (Pfizer). The initial patenting of Viagra compounds was in 1991 and 1992. Its indication was as a medicine against hypertension and angina dispensed in a non-oral form. In 1994 Pfizer tried to file a new patent for the new delivery method - the oral tablets (Dwivedi et al., 2010, pp. 326-327). “The matter reached the courts in November 2000. The judge found that the only difference between prior art and the claims was the suggestion of oral use, which did not constitute inventiveness. He declared the patent invalid…There was nothing in the specification which suggested that there were any difficulties in oral administration which needed to be overcome by adapting the compound for oral use“ (Dwivedi et al., 2010, p. 327).

Financial aspects

The level of the investment into the change of the delivery method, as well as the fees which would be linked to a possible litigation to protect the possibility of prolongation of the patent, should be outweighed by expected revenues.

3.2.6 Combination of known drugs into one product (Fixed Dose Combination (FDC), Free Dose Combination (FrDC))

Table 7: Key characteristics of combination of known drugs method

Description	Combination of drugs
Legality	Legal
Financial aspect	Possibility of even higher revenue than for single products apart
Possible prolongation	5 years

Source: own Table

Description

“Drug combination is an innovative life cycle management strategy through which patients and the drug developers benefit” (Rikkala, 2020, p. 1). Through the drug combination strategy, the field of therapy and the patient’s population can be expanded. There are two types of *drug combinations* as a tool of LCM. This is a *fixed dose combination (FDC)* and a *free dose combination (FrDC)* (Rikkala, 2020, p. 1).

The *fixed dose combination (FDC)* is a combination of drugs in one tablet, which should serve the increase of the product effectiveness, as well as help to overcome the pill burden. Such medicines serve simplification of some treatments bringing the benefit to a patient on the one hand, and helps the company to safeguard revenue level on the other hand. Such combinations get market exclusivity of 5 years (Kakkar, 2015, p. 1357; Gupta et al., 2010, p. 6; Bhat, 2005, p. 115).

Free dose combination (FrDC) is a drug combination of several pills for the treatment of a decease, whereby the dosages of pills can be adjusted. The FrDC can be a commercial success in the field of a combination therapy (Rikkala, 2020, p. 1).

The FDCs are used in a wide spectrum of treatments. Among them is diabetes treatment, for example the drug Steglujan (Merck) is a combination of two drugs; psychological diseases, like Symbyax (Eli Lily) is a combination of components and is used in bipolar disorder; HIV and hepatitis C treatments, where such FDCs as Combivir, Triumeq (GlaxoSmithKline), Harnovi (Gilead) and Akynzeo (Riemser Pharma) are used, helping against the side-effects of chemotherapy (Rikkala, 2020, p. 5; Kakkar, 2015, p. 1357).

FrDC is frequently used in the oncology. An example is drug Afinitor, followed by Afinitor Disperz (Novartis), which is used in treatment of negative breast cancer (Rikkala, 2020, pp. 5 -6).

Legal considerations

"The regulatory authorities have recognized the importance of FDC drug products on public health by developing relevant guidelines" (Desai et al., 2012, p. 3). The risk of getting into litigation process is quite low. As for FDC the product gets a patent protection due to its novelty. In case of FrDC the generics company would need to produce different types of generics, which is a quite complex process (Kakkar, 2015, p. 1357; Gupta et al., 2010, p. 6; Bhat, 2005, p. 115).

Financial aspects

Well-branded FDCs help not only to safeguard, but even to increase revenues. Thus, an example is a drug BenzaClin (Valeant). This drug is a combination of two ingredients which can be separately bought in a pharmacy. Nevertheless, if to compare the summarized price for the ingredients separately available, the prices separately for each component drug would be lower. Thus, BenzaClin (Valeant) price is 3.6 times higher than the total price of separate tablets. The same is in the case of the drug Acanya (Valeant). Acanya as a single tablet costs 5 times more than the price for its component tablets (Siddalingaiah & Fugh-Berman, 2022, pp. 1122-1123).

When looking into financial aspect of FDC, the higher revenues should be considered in combination with the height of R&D investment needed. The process of development can bear challenges due to its complexity. "If combined drug strengths are too high (>1000–1500 mg), the tablet size of the FDC product can become critical in achieving patient acceptance" (Desai et al., 2012, p. 4).

3.2.7 Introduction of own generics

Table 8: Key characteristics of introduction of own generics method

Description	Sales of own generics parallel to branded drugs
Legality	Legal
Financial aspect	Helps to make the sales loss less steep; by increasing the sales rent up to 3.2% vs the scenario without own generics launch
Possible prolongation	No patent prolongation

Source: own Table

Description

The launch of *own generics*, while having a well branded product on the market, belongs to a limited corporate diversification strategy (Barney & Hesterly, 2010, p. 190; Raasch, 2010, pp. 89-90). Own generics is launched to a price-level which is close to that of generics companies, but still is by 0,5% - 1,6% higher. In such a way the sales rent can be increased up to 3.2% (Reiffen & Ward, 2007, p. 253). This strategy gives a possibility to still profit from economies of scale and to keep market share. At the same time, it serves to discourage the generics companies-competitors to introduce generics substitutes to the market (Barney & Hesterly, 2010, p. 191; Reiffen & Ward, 2007, p. 255; Chandon, 2004, p. 66). The company-originator can then distribute its own generics by itself or license it out (Löfgren, 2007, p. 4).

When applying this strategy, it is advantageous to launch own generics before the patent expiration of the branded product. In such a way the “first mover” advantage is secured. Entering the market simultaneously with other generics could mean stronger competition and can be less successful (Raasch, 2010, pp. 89 – 90; Reiffen & Ward, 2007, p. 252).

An example is the launch of own generics by Lipitor (Pfizer) introduced end of 2011. The launch happened in parallel to the entrance of products of generics companies-competitors into the market. Whereby Pfizer made a distributional agreement according to which the partner-distributor would give Pfizer 70% of revenue made. In such a way Pfizer kept some market share and assured protection of some part of sales which otherwise would overgo to generics (Ku, 2015, p. 599).

Legal considerations

The method of brining of own generics to the market is legal. It is not anticompetitive and does not violate the law. All litigations started by generics firms trying to sue against this method of LCM, ended up without success (Lehnhausen, 2017, p. 47).

Financial aspects

The introduction of own generics method helps the originator companies to guard their market shares and thus to guard higher profits towards the profits which would be generated after patent expiration without own generics on the market (Lehnhausen, 2017, p. 47).

The company-originator has an advantage towards generics companies as it already has all needed approvals to launch own generics. Also, it can launch the own generics much earlier than the core patent expires, thus saving itself those customers who would otherwise switch to competitor´s generics product. Moreover, the economies of scale give the company-originator an advantage in production cost per unit. In such a way, some generics companies might be discouraged to enter the market and thus the number of competitors can diminish. When all these effects sum up, the sales of branded goods after generics entry are higher by up till 3,2% than in the scenario when a company-originator does not bring its own generics product (Reiffen and Ward, 2007, pp. 252 - 254).

3.2.8 Multiple divisional patent applications, strategic patenting

Table 9: Key characteristics of strategic patenting method

Description	Patenting of processes along with compounds
Legality	Contradictory (Art 102 TFEU)
Financial aspect	Sales secured through patent protection
Possible prolongation	The longest additional patent protection, in some examples 15 years were achieved

Source: own Table

Description

One of the ways to avoid the loss of the patent protection is by means of the *application for a number of patents*, covering various aspects of the product in such a way, that at the expiration of one patent another patent gets valid and as a consequence the patent protection gets prolonged (Glasgow, 2001, p. 234). Such method as an attempt to fight against the generics entrance became widespread and is called "*strategic patenting*". Thus, not only patent applications for compound molecules, field of treatment, processes are filed, but also for dosing, delivery systems, screening methods and others. Such patents are called *secondary patents* (Bhat, 2005, pp. 117-118; Raasch, 2010, p. 81; Gorgula, 2020, p. 1067). "Therefore, even after the basic patent protecting an active compound expires, a drug may still be protected by other secondary patents" (Gorgula, 2020, p. 1067).

According to Raasch (2010), the quantity of patents protecting one medicine varies between 20 and 40 (p. 81). This aims the fight against generics by means of building a "multilayer defense" (Philipp, 2010, pp. 51-52). If the launch of generics would violate any of the patents, this would cause a litigation and generics company would be sued for damages. Accordingly, "strategic patenting" serves to enhance the complexity, as well as to increase the cost of market entrance for generics companies and as a result to deter the generics companies to enter the market (Raasch, 2010, p. 81; Philipp, 2010, pp. 51-52; Ku, 2015, p. 599).

The examples of the application of the strategic patenting method are as follows: Merck has filed a patent for the kit of Fosamax; AstraZeneca has filed a patent for a spray-container of Pulmicort, used in treatment of asthma; BMS (Bristol Myers Squibb) has patented the software for dispense of Thalomid (drug used in treatment of cancer); SmithKline has prolonged the patent protection of Augmentin (antibiotic) by 15 years using strategic patenting (Bhat, 2005, p 118; Glasgow, 2001, p. 234).

Legal considerations

The legality of strategic patenting method is contradictory. On the one hand, there is argumentation that this method abuses Art 102 TFEU (prohibiting abuses of technological development) due to its negative impact on the wish and incentive to

innovate and thus is doubtful in terms of competition law (Gorgula, 2020, pp. 1071, 1073, 1075).

On the other hand, the legality of this practice bases on the argument that the stronger the patent is protected, the more is the company`s incentive to invest into innovation, as in such a way the innovator´s reward is increased (Gorgula, 2020, p. 1073).

Financial aspects

Viewing the time impact of such a method of LCM, strategic patenting represents the longest additional patent protection a company can achieve for its product. This in its turn would increase the brand attachment of patients in such a way, that even after the expiration of the secondary patent, the company still can benefit. At the same time, one should leverage the additional revenue against the costs of patents, growing during the patent life from year to year, as well as fees, if an attempt of litigation according to Art 102 TFEU would be raised (see Appendix C on patent cost).

3.2.9 Harvesting strategy

Table 10: Key characteristics of harvesting strategy method

Description	Bases on brand loyalty: customers remain loyal to the brand even after generics entry
Legality	Legal
Financial aspect	Short-term strategy, skimming of revenues
Possible prolongation	No patent prolongation

Source: own Table

Description

Harvesting strategy is a leadership and niche strategy, which builds upon a strong brand loyalty, whereby the customers would remain with brand despite the difference in price towards the generics. Company aims to remain in the business even though the business declines. With such a strategy the possibility to safeguard the revenue level is considered to be a short-term strategy. The application of the harvesting strategy implies trying to get as much revenue as possible during the patent termination period. However, the revenue can be sustained by means of the promotion of the

product (Chandon, 2004, p. 66; Barney & Hesterly, 2010, p. 58). Harvesting strategy makes more sense versus divestment strategy (see subchapter 3.2, p.17) for companies having a stronger brand value on the market (Barney & Hesterly, 2010, p. 58).

Legal considerations

The strategy is legal as long as it conforms to BJR, "wonach eine verantwortungsbewusste, unternehmerische Handlung auf Grundlage sorgfältiger Abwägungen benötigt wird" (Willen, 2019, p. 7).

Financial aspects

This strategy does not demand any heavy investments like R&D, or patent fees, or new filing fees. However, if a company wishes to invest into promotion, its cost should not outweigh the revenues.

3.2.10 Switching branded prescription drugs to over-the-counter

Table 11: Key characteristics of switching of branded prescription drugs to over-the-counter method

Description	Change of the prescription form, can be accompanied by adjustment of price
Legality	Legal
Financial aspect	Safeguarding or maximizing revenues through the increase of the sales volume
Possible prolongation	No patent prolongation

Source: own Table

Description

The method of switching from the prescription form to an *over-the-counter* (i.e. free purchasable drugs) is usually forced by the "threat of generic competition" or by ambition to maximize profits (Hollenbeak, 1999, p. 661).

An adjusted price strategy in a combination with the change of the medicine form from the prescription one to an over-the-counter one, can be also seen as effective means

in competition against the entrance of generics and safeguarding the level of profits. The prerequisite for it is a product profile, which would allow the switch in terms of safety (Kakkar, 2015, p. 1357).

Such switch is normally done in the later life-cycle-period of the product. One of the ways of such a switch is to market smaller dosages of the medicine. The basis for this switch strategy is the loyalty of the patients to a product, which bases on good experience with the product. Examples of application of this method are such brands as ACC akut, Zovirax, Nicorette, Lisino (Raasch, 2010, p. 96). The limitation of the switch to over-the-counter (in the following “OTC”) product strategy is linked to the fact that there are not many areas in which OTC can be applied to prescription drugs (Raasch, 2010, p. 97). However, due to a considerable size of OTC market, estimated to surpass USD 179 bln in 2018, as well as due to its remarkable growth, this method might be of high economic potential and thus interesting for a pharmaceutical company-originator (Kakkar, 2015, p. 1357).

Legal considerations

From the legal perspective this strategy is legal and does not bear any risk of litigation. The switch from the prescription drugs form to the OTC drugs form is linked to the change in the legal status of the drug, its reimbursable status, and its marketing strategy (Raasch, 2010, p. 96).

Financial aspects

The estimation of financial scenario in application of the switch from prescription drug to OTC is complex. On the one hand, such switch can go along with the cut of prices. The possible price cut can be a strategical decision in view that the product gets into the out-of-the-pocket market, which is more price-sensitive. Thus, the elasticity of demand for the given drug is important (Danzon, 2014, p. 8). If the company decides to cut the price to the level, similar to generics price, then the revenue per single unit of product would fall. Still, due to the “free purchasable” drug status, the total sales might remain high as sales volume might increase (Mousavi et al., 2022, p. 2). The growth of the sales volume can be also facilitated by advertising. In the European Union the advertisement of OTC products is allowed whereas the advertisement of the prescription drugs is forbidden (Kvesic, 2008, p. 299). Though timing does not have

the key role for the change to OTC form, nevertheless, it is advisable to do a switch before the patent expiration, thus saving market share versus the generics companies (Kvesic, 2008, p. 299).

Another scenario may be, that the analysis of elasticity of demand might show the possibility for an increase of the price. In such a situation the value of sales can be raised through the price increase (Hollenbeak, 1999, p. 662).

3.2.11 "Pay - for – delay" strategy

Table 12: Key characteristics of the "pay-for-delay" method

Description	Payment to a generics company for coming later into the market
Legality	Questionable in the light of competition law, depends on the "rule-of-reason" analysis
Financial aspect	Average 17 months profit maintenance, however the examples from praxis show years of prolongation; 6% stock price increase as soon as the deal is announced
Possible prolongation	No patent prolongation

Source: own Table

Description

The "*pay-for-delay*" method is a strategy which implies an agreement between a pharmaceutical company-originator and the generics company, whereby the company-originator pays for "delay" in commercialization of the generic drug (Danzon, 2014, p. 35). Such deals may result in safeguarding of the price level of the branded drug, which can be up to 10 times higher, than the price level of generics (Danzon, 2014, p. 35). Despite its questionable nature in the light of competition law, this method is nevertheless quite often used in the pharmaceutical industry (Kakkar, 2015, p. 1355; Choi et al., 2014, p. 44; Danzon, 2014, p. 21).

The deep analysis of settlements between brands and generics conducted by Drake et al. (2014) confirm that the "pay-for-delay" strategy serves well the profit maintenance by originator despite the patent expiration (p. 2). According to Choi et al. (2014), the

“pay-for-delay” strategy gives the company-originator in average supplementary 17 months after the main patent expiration and before the generics enter the market (p. 50).

Another positive effect for the company-originator in case of application of a “pay-for-delay” strategy is that as soon as the information about such an agreement is published, the stock market reacts in a positive way. The accomplishment of a “pay-for-delay” deal takes away the uncertainty regarding the nearest future. As a result, the stock price of the company-originator raises by approximately 6 percent (Drake et al., 2014, pp. 5, 29).

Pfizer used the “pay-for-delay” strategy when its blockbuster Lipitor (cholesterol medicine brining sales of USD 12 billion p.a.) was about to lose its patent protection. Pfizer made a deal with Rambaxy Laboratories (a generics company) which resulted in a postponement of the launch of generics of Lipitor from 2003 to end of 2011, gaining in such a way around 8 years of additional exclusivity (Ku, 2015, p. 599).

Legal considerations

“Market allocation agreements among potential competitors are per se illegal” (Balto, 2000, p. 334). Settlements signed with a purpose that a generics company would postpone its market entry against a payment “has the potential to harm consumers” (Drake et al., 2014, p. 10). Such deals are not conform with antitrust policy. And still patent-litigation settlements are practiced (Cook, 2011, p. 417). The contradictory nature of patent-litigation settlements legality is seen when looking into decisions of courts, which in some cases confirm their legality and thus validity, but in some cases don´t (Ku, 2015, p. 599). The discrepancy comes from the outcome of the “rule-of-reason” analysis application (Danzon, 2014, pp. 21-22). Under the “rule-of-reason” analysis the decision whether the deal is anticompetitive or not is dependent from the “magnitude and reasonableness of the payment” (Danzon, 2014, pp. 35-37). Here the balance between costs and benefits is examined, as well as whether the deal is met within the intellectual property rights or the antitrust law is abused (Boscheck, 2015, p. 226; Abbott & Michel, 2005, p. 26).

For example, the settlement between Bayer (company-originator) and Barr Laboratories (generics company) on the product Cipro (antibiotic), whereby Bayer paid

USD 400 Mio for a delay by 6 years, was recognized by the court as legal and valid (Cook, 2011, p. 418).

In those cases when the settlement is proved as illegal, it ends up with lawsuits and considerable penalty fees. For instance, in the “pay-for-delay” case of Citalopram, whereby Lundbeck (company-originator) tried to postpone generics entry, the deal was found illegal based on violation of Article 101 of the EUR Treaty (Case COMP/AT. 39226). As a penalty Lundbeck had to pay a fine of EUR 93.8 Mio, whereby its generics partners (Alpharma, Arrow, Ranbaxy, Merck KGaA/Generics UK) had to pay a fine of EUR 52.2 Mio (Zafar, 2014, pp. 207-208; Danzon, 2014, p. 45).

To diminish the risk of litigation, when getting into such settlements, the company-originator should be very careful about the wording. The focus in wording should lie “on protecting IP and other legitimate rights, rather than on exclusion per se” (Zafar, 2014, p. 207). The deal should be done before the patent expiration. If there is a litigation, the court would examine whether the patent is still valid and might see the settlement legal. However, if the court does not find the patent valid, the settlement would be found illegal (Abbott & Michel, 2005, p. 34).

Financial aspects

The calculation of what might be worth to pay for a delayed entry of generics bases on the timeframe within which the opportunity revenues would be kept. In general, the “pay-for-delay” agreement assumes that no generics can enter the market within 6 months or 180 days (a period of the exclusivity right of the generics company with which the settlement is signed) (Balto, 2000, p. 333).

Some companies use for the calculation of the “pay-off” the probability, with which a generics company would have a chance to win the litigation. This probability, expressed in per cents, is then multiplied by opportunity revenues. Thus, if the chance that the generics company would win is around 25%, the company-originator tends to “pay up to 25% of the value of its monopoly to exclude its competitors without a trial“ (Abbott & Michel, 2005, pp. 26-27).

In the scientific literature the following formula is proposed to calculate the payoff (V_b):

Formula 1: Payoff calculation

$$v_b = (1 - \theta_b)\pi^m + \theta_b\left(\pi_b^c - x_b - x_g\right)$$

Source: Choi et al., 2014. p. 47

In the formula "Xb and Xg represent the litigation costs of the branded pharmaceutical and generic companies, respectively" (Choi et al., 2014, p. 47).

3.2.12 Licensing, cross-licensing

Table 13: Key characteristics of licensing/ cross-licensing method

Description	Licensing out of patent rights
Legality	Legal
Financial aspect	Royalties or one-off payment
Possible prolongation	No patent prolongation

Source: own Table

Description

One of the options of actions alternative to product-withdrawal is *licensing out* of the patent rights, as well as *cross-licensing*.

The licensing out can be of two scenarios. The first one is the licensing out with further participation in success of sales by means of getting regular compensation in form of royalties, annual fees, or some other kind of compensation, which is accompanied by participation in risk as well. The second one is the licensing out with complete carry over of rights for the product for an agreed price and thus getting a one-off payment (Raasch, 2010, p. 85; Chandon, 2004, pp. 66-67; Simonet, 2002, pp. 329, 331).

The cross-licensing is an agreement in which companies share their knowledge on certain products to create a product-combination. This is often used in vaccination, whereby one injection would vaccinate against several diseases (Simonet, 2002, p. 329).

Licensing is more advantageous versus acquisition of a product since it is less time consuming and thus "facilitates the pre-emption of the market", minimizing the risk of the loss of the market share to competitors (Simonet, 2002, p. 330).

Legal considerations

This method does not infringe the law and thus is legal. According to the Patent Act “a patentee may grant a license to a limited territory, allowing it to establish a geographic market allocation” (Abbott & Michel, 2005, pp. 19-20). However, the companies-competitors can try to start a litigation. A possible result of a litigation can be that a licensee might have to stop selling a product for a certain period in exchange of recognition of its exclusionary rights. Such an agreement would be based on an arms-length settlement and would represent “the most accurate assessment of the subject patent’s exclusionary power” (Abbott & Michel, 2005, pp. 13-14).

Financial aspects

The regular fees the licensee would pay depend on how high the revenues are expected to be and how probable it is that a possible litigation would happen (Abbott & Michel, 2005, p. 13).

3.2.13 Strategic pricing

Table 14: Key characteristics of strategic pricing method

Description	Price decrease
Legality	Legal
Financial aspect	Contribution margin is guarded through sales volume
Possible prolongation	No patent prolongation

Source: own Table

Description

Strategic pricing method is a defensive strategy, whereby the price is decreased to be competitive with possible generic rivals and in such a way to guard market share (Bansal et al., 2009, p. 300; Kakkar, 2015, p. 1355; Kvesic, 2008, p. 298). According to Kakkar (2015), strategic pricing is “the most cost- and time-efficient approach” (p. 1355).

The price decrease on the branded product targets to guard the sales volume and to demotivate generics companies to enter the market. It is better to implement this

strategy before the patent expiration date and consequently to prevent the shift of patients to another product (Kakkar, 2015, p. 1355; Raasch, 2010, p. 101).

When considering the usage of the strategic pricing method, the management should take into consideration the consequences, which might follow in view of parallel imports between the countries having different price levels for the same product (Raasch, 2010, p. 100).

The examples of the implementation of strategic pricing method are products Zocor (Organon) and Lipitor (Pfizer) (Kakkar, 2015, p. 1355).

Legal considerations

The process of price setting in pharmaceutical industry is regulated. In order not to abuse the law, the price change should be done in agreement with local authorities (Raasch, 2010, p. 68).

Financial aspects

From the technical point of view, the method is easy to implement without any investment needed (Raasch, 2010, p. 101).

The effects resulting from strategic pricing method, like keeping of the market share, diminished generics rivalry and guarding of sales volume, serve safeguarding of the contribution margin on a level, which would allow the pharmaceutical company to retain the profitability of the product (Raasch, 2010, p. 100).

3.3 Summary and considerations about the usage of methods

„Business is about creating value" (Grant, 2005, p. 39). To secure the value creation on a longer run in the pharmaceutical industry, enabling the return of the invested money and profitability of a product also after core patent expiration, the originator companies use various strategies to prolong their monopoly. According to Kvesic "Life Cycle Management strategies … allow pharmaceutical companies to protect their investment and achieve the full value of return" (2008, p. 294).

According to Reiffen and Ward (2007) the postponement of the generics entry by one year would save around 10% of profit (p. 251). To secure the success of maximization

of patent protection timeframe, appropriate strategies should be thought through well in advance and implemented before the patent expires and the generics enter the market. For this matter a close collaboration with scientists and attorneys of the company is needed (Gupta et al., 2010, p. 6).

The market conditions, getting more and more stringent, force companies to be more vigilant in trying to make the best of their products and to get the highest profit possible. Life cycle management gets indispensable and needs to be planned well in advance before the patent expires. “Such early planning and monitoring of progress can facilitate evaluation of a product’s economic potential and aid in planning and successful implementation of other LCM strategies“ (Kakkar, 2015, p. 1355)

4. Assessment matrix of options of actions for strategical decisions after core patent expiration

“This […] is, above all, an exercise in the comprehension of complexity” (Igor Ansoff in Eschenbach et al., 2008, p. 57).

In this part the methods of LCM with the decisive parameters are put into one matrix to present the options of actions in one overview for the purpose to support the decision-making process.

Definition of options of actions

The options of actions can be seen as possible scenarios of strategy and approaches for scenario-planning (Fink and Siebe, 2016, p. 40). The strategy is serving the creation and preservation of the potential for success (Gälweiler in Eschenbach et al., 2008, p. 200). Scenarios belong to the established methods of management of future (Fink and Siebe, 2016, p. 42). A process of scenario-building consists of preparation, development, and interpretation of the scenarios of the future (Fink and Siebe, 2016, p. 53).

In this part a matrix and supporting graphs are presented based on which the management of a pharmaceutical company can look at options of actions and assume, which opportunities and risks are bound to each possible LCM method, and to decide which options are the most suitable for the company (Fink and Siebe, 2016, pp. 48, 163).

The scenarios of possible strategy which are described in this thesis are steering scenarios. The core field of the application of scenarios is the strategic direction of companies and business areas (Fink and Siebe, 2016, pp. 52, 169).

4.1 Methodology and parameters of the assessment matrix

The management-team needs to take decisions, which strategy to apply after the core patent expires. According to the *Game theory* to take a decision one needs to have action alternatives, the knowledge of environment, as well as the results of the decision should be measurable (Wessler, 2012, p. 2).

The action alternatives are depicted in the part 3 of this master thesis. The environment knowledge is depicted in the part 2. The measurability and the prognosed impact of possible decision can be appraised based on the key parameters defined (market share parameter, financial parameter and legal parameter). After the LCM method is chosen, the scenario prognosis, also named “Blick in die Zukunft”, is conducted (Fink and Siebe, 2016, p. 88).

The following parameters are identified as important for the decision-making process:

Market share

Market share, its development within the application of a given LCM method is an important parameter. Market share permits to guard the cumulative output and the market power of business and has a positive correlation to ROI (Buzzell et al., 1975, pp. 97-98).

Financial

Financial or the expected profit parameter is a second chosen parameter. It serves the examination whether a project is worth to be conducted from economic point of view. According to *Bernoulli principle* each decision bases and depends on the profit or benefit coming out of it. Thus, a decision with higher benefit would outweigh the decision with a lower one (Schütte, 2009, pp. 33-34). In the praxis the quantification would be linked to the longevity of additional patent or a different pathway enabling a company to guard the revenue.

The financial parameter consists of two elements: discounted cash-flow (which shows the present value of expected revenue development) and the magnitude of the investment needed. Discounted cash-flow (in the following “DCF”) diminished by investment needed result in net present value (in the following “NPV”). NPV shows whether it is worth to invest into a project. With a positive NPV one proceeds with the project (Brealey, 2020, pp. 124, 275).

Legal parameter

The legal risk or risk of litigation is another parameter which needs to be considered. Thus, according to Dukes (2006) a litigation can impact both the well-being and reputation of a pharmaceutical company tremendously (p. 61).

After looking at the named parameters, a decision can be taken. Here one can use either Maxi-Max or Mini-Max principle. The Maxi-Max principle would choose the best of the best options and is normally the path of risk takers. The Mini-Max principle would choose from bad options the least bad one (Wessler, 2012, p. 2).

The decision-making process, comprising the chosen parameters, is based on the *Laplace-rule*, which assumes, “dass man in einer Unsicherheitssituation alle Umfeldzustände als gleichverteilt annehmen kann und setzt die Nutzensummen als Gütemaß für die Entscheidung“ (Schütte, 2009, p. 35). The methodology is based on process of scenario formulation (Fink & Siebe, 2016, p. 181).

4.2 Assessment matrix

Figure 4: Process of scenario formulation

Source: Fink & Siebe, 2016, p. 181

Step A: The scenario field analysis

Before deciding, which LCM method to choose, the current situation with the product on the market, as well as the needs and targets of the pharmaceutical company are to be analyzed within the chosen parameters:

- the market share parameter,
- the financial parameter,
- the legal parameter.

The management needs to look at what is the *market share* (in the following "MS") and its development at the current moment.

The analysis of the *financial parameter* would comprise the current yearly sales (forecast for the current year) and the development of the sales within the nearest past – two last years.

The analysis of the *legal situation* would comprise the analysis whether the company would be ready to bear the litigation fees and negative publicity in case of litigation, and following consequences, like possible decline of the stock price (Bonini and Boraschi, 2010, p. 125).

As the result of the analysis of the current situation within the chosen parameters, the current state is defined, and the following table is filled in.

Table 15: Definition of the current state

Parameters	Current state
Market Share (MS)	What is the current MS
Financial	Current yearly sales
Legal	Willingness to take legal risk

Source: own Table

Step B: The scenario prognosis evaluation

After the scenario field analysis, the scenario prognosis evaluation is done. The result of such an evaluation should be a narrowed down list of possible LCM methods suitable for the product and the pharmaceutical company. The list should be narrowed down to maximum of 3-4 LCM methods.

In step B the following tasks are fulfilled.

1st step: Definition of the targeted state

At first, the management needs to decide on the targeted state it wants to get to by means of application of the LCM method according to each of the three parameters chosen.

Thus, the management needs to decide, what is acceptable and what is wished regarding the further development of the *market share*.

The analysis of the *financial parameter* for the targeted state would comprise the acceptable or wished sales development, as well as the investment needed to implement the LCM method. Further, in the step C, this information will be needed for calculation of the NPV of the method coming into the narrower consideration (see subchapter 4.2, p. 51).

The analysis of the *legal situation* would comprise the analysis whether the company would be ready to bear the litigation fees and negative publicity in case of litigation, as well as following consequences, like possible decline of the stock price (Bonini and Boraschi, 2010, p. 125).

Within this process the table “Definition of the targeted state” needs to be filled out.

Table 16: Definition of the targeted state

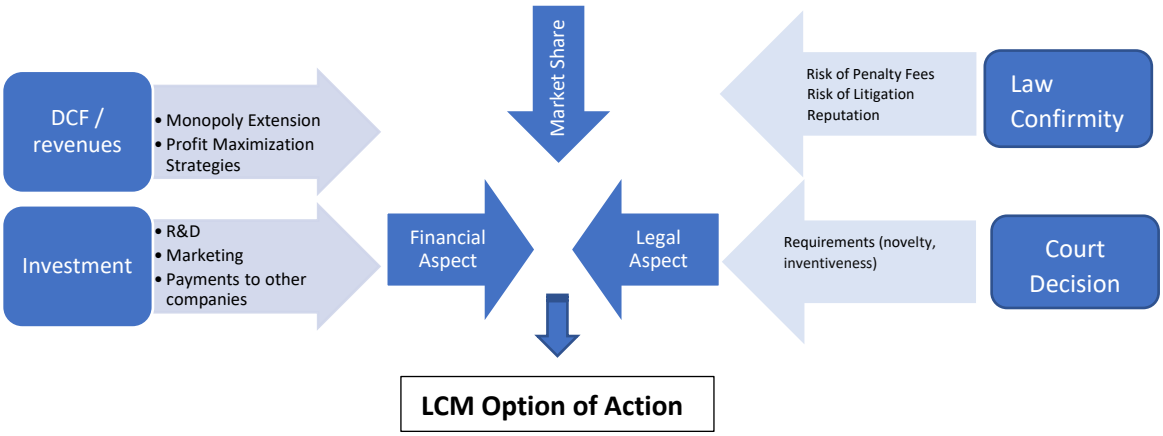
Parameters	Current state	Targeted state
Market Share (MS)	What is the current MS	Same, increase, decrease
Financial (targeted revenue & investment needed)	Current yearly sales	Targeted revenue level p.a. & possible investment into method implementation
Legal	Willingness to take legal risk	Quantification: maximum bearable amount of litigation fee

Source: own Table

Subsequently the LCM methods which could be suitable are filtered out by means of screening according to chosen parameters. The following matrix in figure 5 depicts the process of decision-taking of choosing the LCM methods for a given drug.

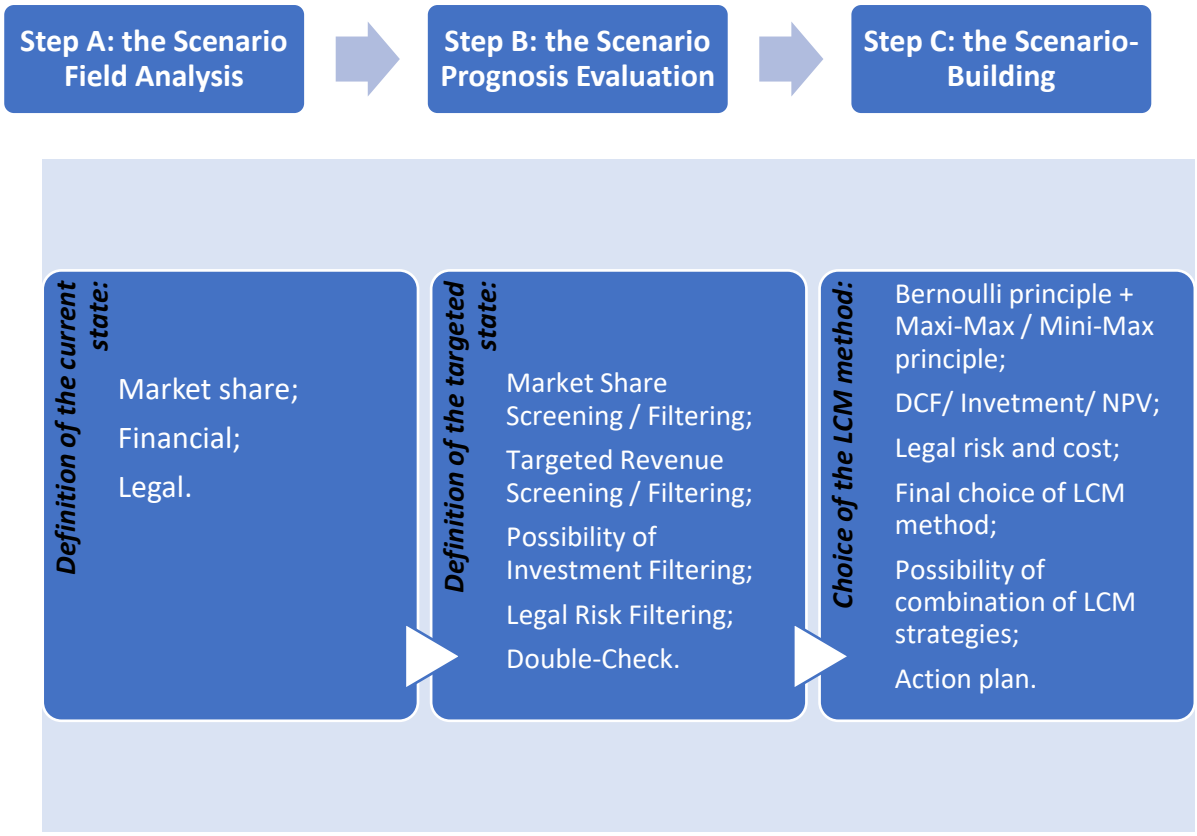
Figure 5: Matrix of the decision-making process

(1) General overview of parameters impacting the decision-making



Source: own Graph

(2) Processual overview of decision-making



Source: own Graph

The decision-making process comprises several steps and is done in the form of screening/ filtering, whereby the screening/ filtering through each targeted parameter is done. Thus, the management checks the target for the given medicine, set for a

given parameter, and chooses the LCM methods which fulfil the targeted state per parameter. To simplify the screening, the following graphs, serving the visualization of each parameter of the LCM methods have been developed: LCM methods` influence on market share development (Table 17), LCM safeguarding revenue after core patent expiration (Figure 6), LCM investment level (Figure 7), LCM methods legal risk intensity (Figure 8).

2nd step: Market share screening / filtering

The management first identifies the suitable LCM methods based on targeted market share with the help of Table 17 (LCM methods` influence on market share development). In the Table 17 three categories of the development of market share are depicted: diminishing, stable, and growing. The prognosed behavior of market share after application of a given LCM method is indicated by means of a star.

Table 17: LCM methods´ influence on market share development

		Market Share Development		
Nr	LCM Methods	Diminishing	Stable	Increasing
1	Divestiture	★		
2	Second generation drug		★	★
3	Harvesting strategy	★	★	
4	New uses & new treatment		★	★
5	New delivery method & new dosage		★	★
6	Combination of known drugs into one product		★	★
7	Introduction of own generics	★	★	
8	Strategic patenting		★	★
9	Harvesting strategy	★	★	
10	Swith to over-the-counter form		★	★
11	Pay-for-delay		★	
12	Licensing /cross-licensing	★	★	
13	Strategic pricing	★	★	

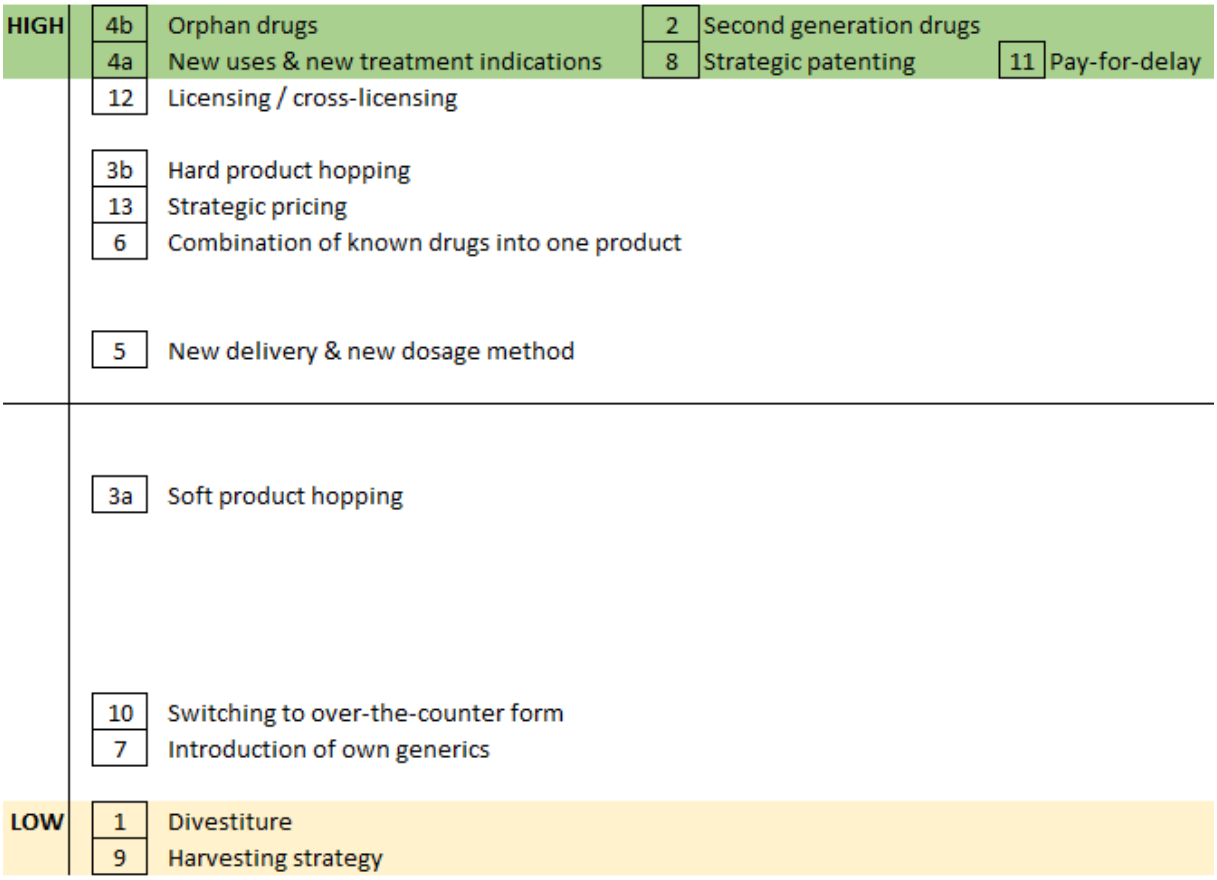
Source: own Table

3rd step: Targeted revenue screening / filtering

In the third step the methods selected in the second step, i.e. chosen according to their suitability in terms of the market share development, get screened/ filtered according

to the aspired revenue level. For this filtering the Figure 6 is used (LCM safeguarding revenue after core patent expiration).

Figure 6: LCM safeguarding revenue after core patent expiration

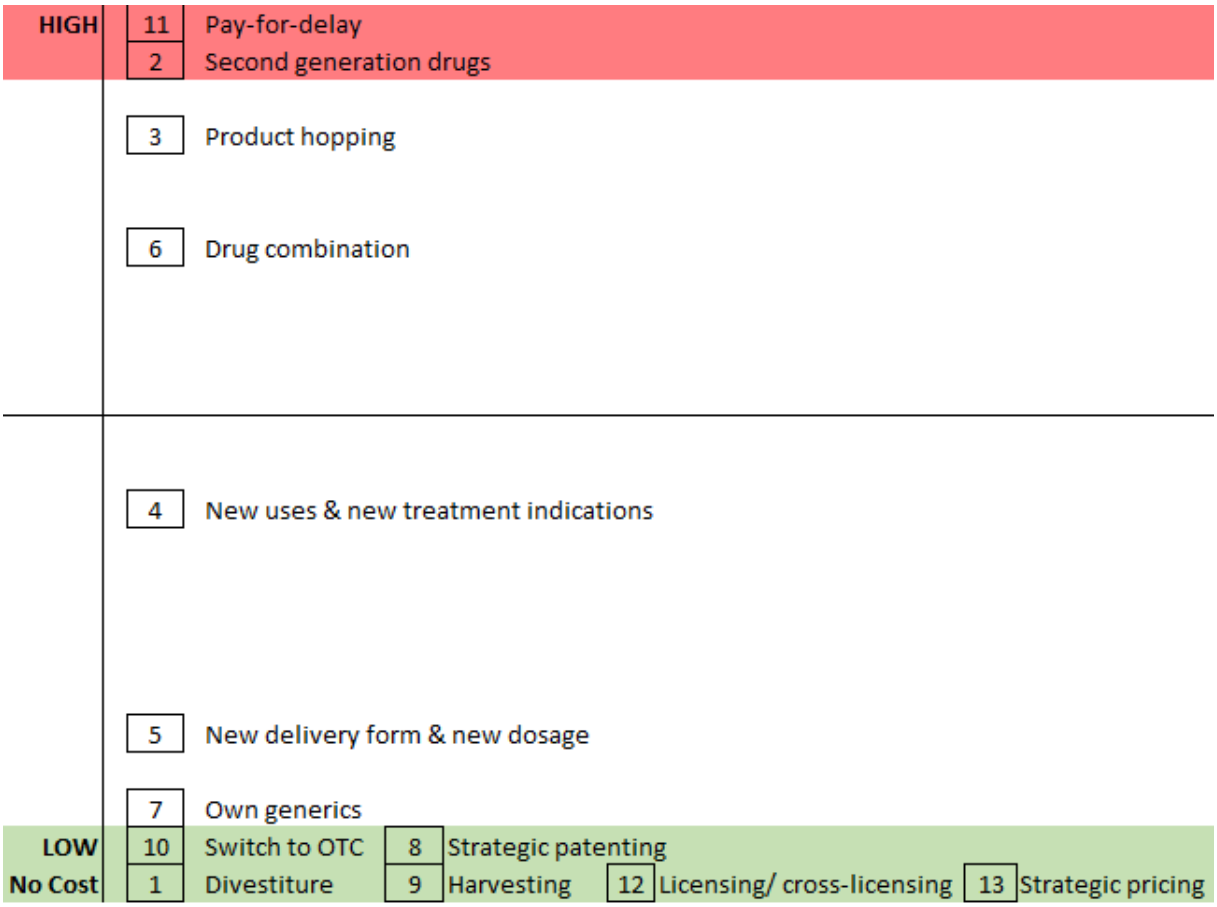


Source: own Graph

4th step: Possibility of investment filtering

In the fourth step the remained LCM methods after the steps one and two get filtered / screened according to the investment height the company is willing or would be ready to do. For this filtering the Figure 7 is used (LCM investment level).

Figure 7: LCM investment level



Source: own Graph

5th step: Legal risk filtering

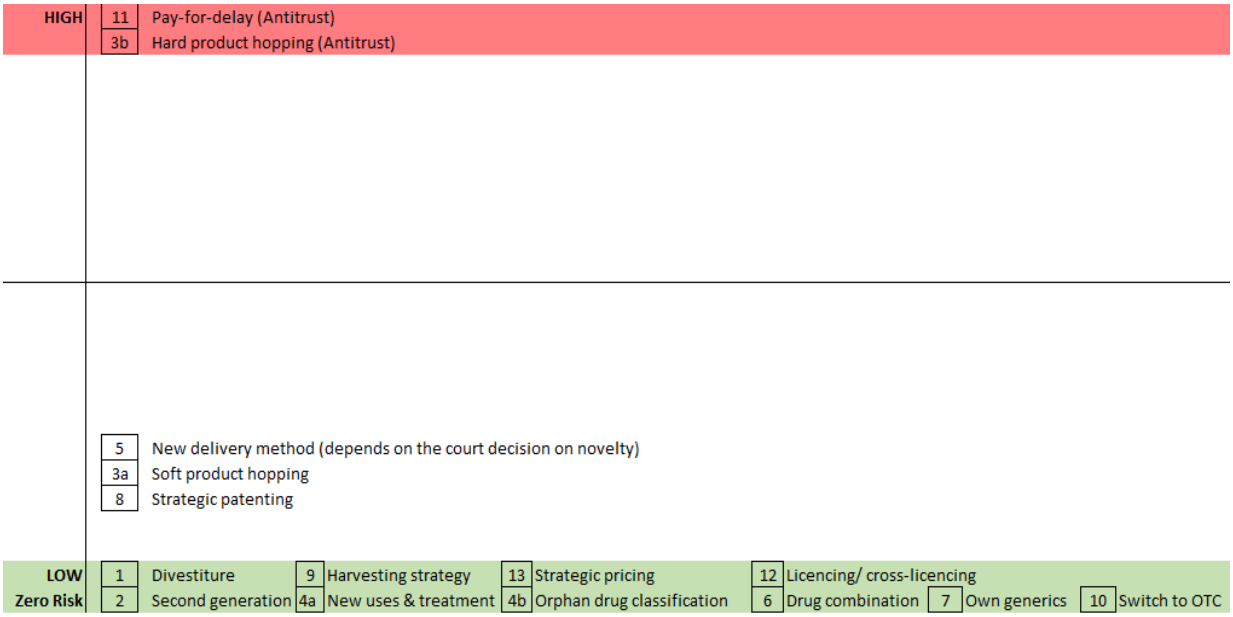
In the fifth step the next screening / filtering takes place. Thus, the LCM methods which remained after application of the filters concerning the market share, revenue development, investment needed, are filtered according to the level of legal risk the company is able/ willing to take.

To take a decision on this point, the management should be clear about which risk-strategy the company pursues:

- risk avoidance (the strongest form of risk reduction),
- risk reduction (to reduce the risk the precaution actions are met),
- risk prevention (building of a reserve to cover possible litigation fees) (Alter, 2019, pp. 242 – 243).

For the method screening/ filtering on risk the Figure 8 is used (LCM methods legal risk intensity).

Figure 8: LCM methods legal risk intensity



Source: own Graph

After screening / filtering step-by-step on the basis of each parameter separately, the double-check whether the chosen methods are conform with the defined target in the step A, takes place. For this purpose, the Table 18 (concentrated table with LCM aspects, their appraisal) is used.

6th step: Double-check

Table 18: Concentrated table with LCM aspects, their appraisal

LCM Nr	1	2	3a	3b	4	4a	4b	5	6	7	8	9	10	11	12	13
LCMs	Divestiture	Second generation drugs	Soft product hopping	Hard product hopping	Patenting of new uses	Pediatric area	Orphan drug	New delivery method	Drug combinations	Own generics	Strategic patenting	Harvesting	Switch to OTC	Pay-for-delay	Licensing/ cross-licensing	Strategic pricing
Add Patent (YRS)	0	7,5	4	4	7	0,5	7	3	5	0	15	0	0	0	0	0
Market Share Development	DIM	STABLE/INCR	DIM/STABLE	STABLE	STABLE/INCR	STABLE/INCR	STABLE/INCR	STABLE/INCR	STABLE/INCR	DIM/STABLE	STABLE/INCR	DIM/STABLE	STABLE/INCR	STABLE	DIM/STABLE	DIM/STABLE
Financial	LOW	HIGH	MEDIUM	UPPER-MED	HIGH	HIGH	VERY HIGH	MEDIUM	UPPER-MED	LOW	HIGH	LOW	LOW	HIGH	MEDIUM	MEDIUM
R&D	NO COST	MEDIUM	HIGH	HIGH	MEDIUM	MED-LOW	MED-LOW	MED-LOW	UPPER MED	NO COST	NO COST	NO COST	NO COST	NO COST	NO COST	NO COST
Legal	NO RISK	NO RISK	MED-LOW	HIGH	NO RISK	NO RISK	NO RISK	MED-LOW	NO RISK	NO RISK	MED-LOW	NO RISK	NO RISK	HIGH	LOW	LOW

*DIM = DIMINISHING
**INCR= INCREASING
***GREEN= POSITIVE IMPACT
****RED= NEGATIVE IMPACT

Source: own Graph

The accomplishment of the described above steps of the screening / filtering process should result in narrowing down of the choice of the LCM methods to maximum 3-4 LCM methods.

The chosen 3-4 LCM methods, suitable for a given product and a given company are then further examined in the step C on their fit for purpose to achieve the targeted goal/ state, formulated in the step A.

Step C: The scenario-building

In step C the quantification of the chosen methods takes place. The management can take the final decision on the basis of Bernoulli principle (according to the profit expected) in combination with Maxi-Max or Mini-Max principle (see subchapter 4.1, pp. 41-42).

As mentioned above, after having narrowed down the choice of possible LCM methods to 3 – 4 methods, the decision which method to choose based on Bernoulli principle can be met (the choice of the most profitable option) (see subchapter 4.1, p. 41).

The calculation of *DCF* for the chosen LCM methods takes place. DCF is used to calculate present value, i.e. value of money discounted by discount rate *r* (Brealey, 2020, p. 124).

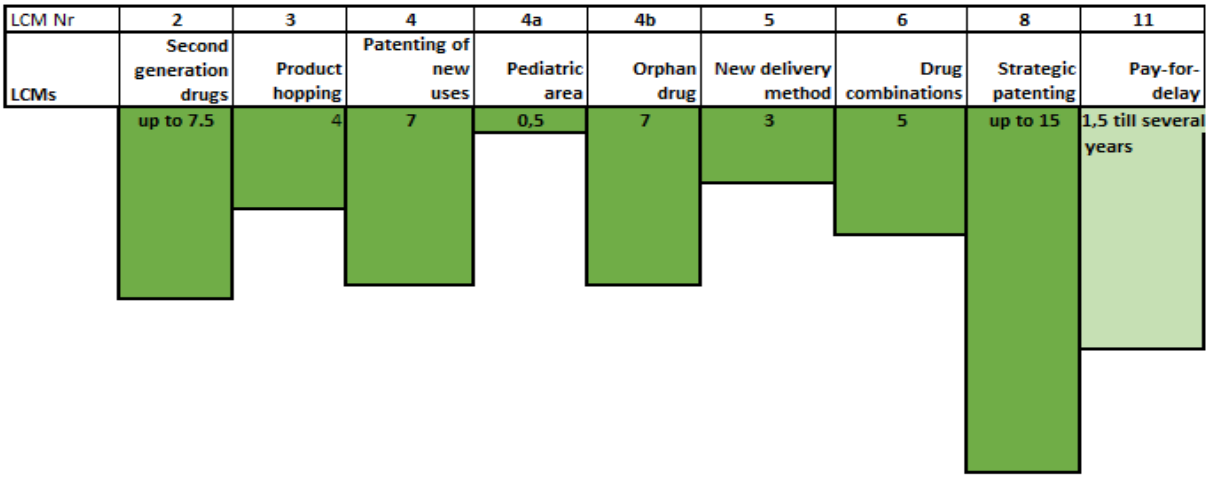
For the calculation of DCF one needs:

1) the number of years which are taken into the calculation,
2) the forecasted revenues for those years.

1st step: The definition of the number of years

If the LCM method belongs to those which comprise the patent prolongation (methods Nr 2,3,4,5,6,8,11), then the number of years taken for the calculation is predefined and can be seen in the Figure 9 (Overview possible additional patent life through LCM (in years)).

Figure 9: Overview possible additional patent life through LCM (in years)



Source: own Graph

If the LCM method does not comprise the patent prolongation, then the time frame for the calculation of DCF is estimated by the management-team.

2nd step: The forecast of the revenue for each year

The sales value can be forecasted on the basis of volume forecast for the given years and the price forecast. The volume forecast would be done according to the prognosis method “Expertenmeinung” (Treyer, 2010, p. 37). “Bei der Prognosemethode gemäß “Expertenmeinung” wird ein Forecast entwickelt, indem die subjektiven Meinungen von verschiedenen Managern, Wirtschaftsfachleuten und Experten erfasst werden” (Treyer, 2010, p. 37).

The price development can be in either direction: decrease, remain stable, increase. In case of discount agreements with insurances (Rabattverträge mit Krankenkassen) – the price can go down despite the patent prolongation (Dietz, 2020, p. 42). Another possibility is that the price remains stable. The third possibility can be, that the price may be increased: as described in chapter 3 of this thesis it can be the case with *orphan drugs* or *over-the-counter-switch* methods. In general, the basis for price development should be checked before the calculation is done.

Formula 2: Revenue calculation

Revenue (year x) = Volume (year x) * Price (year x)

After the information needed for the calculation of DCF is gathered, its calculation is performed.

3rd step: Prognosed discounted cash flow

Formula 3: Prognosed discounted cash flow calculation

$$\frac{(\text{Sales Volume} * \text{price})(\text{year 1})}{(1+r)1} + \frac{(\text{Sales Volume} * \text{price})(\text{year 2})}{(1+r)2} + \frac{(\text{Sales Volume} * \text{price})(\text{year n})}{(1+r)n}$$

4th step: Investment needed

Investment is "Realisierung eines Zahlungsstromes, wobei Einzahlungen (Rückflüsse) später realisiert werden als Auszahlungen" (Slaby & Krasselt, 1998, p. 7). The magnitude of the investment corresponds to the LCM method. Thus, some LCM methods require investment into R&D, some are fees that the pharmaceutical company pays for services, like in the case of *new delivery* method. The magnitude of investment is determined in cooperation with the respective department having knowledge in the field of investment.

5th step: NPV calculation

"Net present value (NPV) measures whether the project is worth more than it costs" (Brealey, 2020, p. 275). The project is pursued if the NPV value is positive (Brealey, 2020, p. 275).

Formula 4: NPV calculation

NPV = DCF – investment

6th step: Potential legal risk and cost

The final parameter to decide on the method is the potential legal cost. This might be linked to a possible litigation. As described in the chapter three, there are methods which have an ambiguous nature from the legal point of view. Such are, for example, the *hard product hopping* method (method number 3b), the "*pay-for-delay*" method (method number 11) (see subchapter 3.2, p. 17). In this case the advice on the magnitude of possible cost from the side of the legal department of the company is needed. As a result, a more complete picture on the profitability of the LCM methods can be achieved. Thus, the Bernoulli principle is respected, according to which the basis for a decision in the first place is the profitability (see subchapter 4.1, p. 41).

However, as the strategical target of a business is not only profitability, but other parameters also need to be taken into consideration as well (Kakkar, 2015, p. 1357; Alter, 2019, p. 241). “The strategic management process requires that a firm engage in an analysis of threats and opportunities in its competitive environment before a strategic choice can be made“ (Barney & Hesterly, 2012, p. 59).

The final decision on the choice of LCM method should be validated from the point of Maxi-Max principle and Mini-Max principle (Wessler, 2012, p. 2). Whereby all parameters of the LCM method need to be taken into consideration and one more time double checked versus the targeted state.

For this the Table 19 (Overview of the chosen LCM methods) needs to be filled in.

Table 19: Overview of the chosen LCM methods

Parameters	Targeted state	LCM method 1	LCM method 2	LCM method 3
Market share				
Finance				
Legal				

Source: own Table

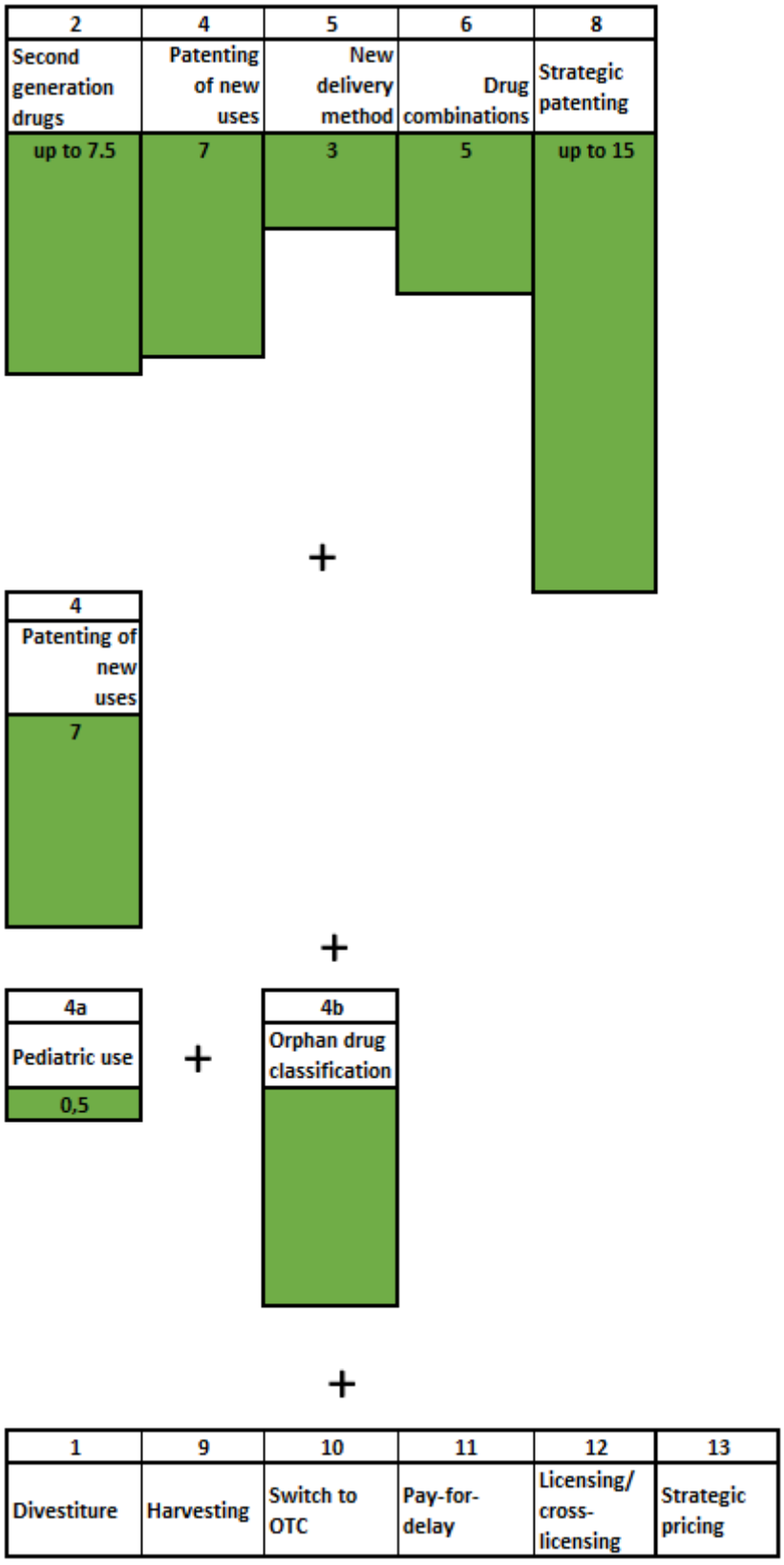
7th step: Final choice of the LCM method

After having the wholistic picture, the decision which LCM method to apply is finalized.

8th step: Possibility of subsequent combination of LCM methods

After defining the LCM method to pursue after the core patent expiration, the examination on application of a subsequent combination of LCM strategies takes place. Figure 10 (Possibility of combination of LCM strategies) serves the basis for the examination of combination of the LCM methods and shows which LCM methods can be combined.

Figure 10: Possibility of combination of LCM strategies



Source: own Graph

If the management decides to use a subsequent LCM method, the steps A, B and C need to be applied to the given LCM method. After that the *scenario prognosis* and *scenario-planning* are conducted (Fink & Siebe, 2016, pp. 40, 88).

9th step: Action plan

As final step the *action plan* should be formulated. The action plan would comprise the tasks to be fulfilled in order the LCM method can be executed, as well as the alignment of the tasks to appropriate departments and decision on the time-schedule for its fulfillment (Mikkelsen & Riis, 2017, p. 87).

4.3 Example of application of the assessment matrix

The case study data is fictive and is given only for the purpose of illustration.

The pharmaceutical company XYZ is a multinational pharmaceutical company-originator, acting in the field of oncology. In 2002 XYZ patented its finding of a molecule to create a medicine for the breast cancer. After 12 years of R&D, in 2014 the medicine under the brand name “Cancer-fight” was brought to the market. Since 2016 throughout till the end of the core patent expiration in 2022 the sales showed growth between 2% and 3% in Europe. In 2022 company gets an SPC, allowing 5 additional years of patent protection. In 2027 the patent protection through SPC is going to end. In 2022 the management needs to take a decision which LCM method to choose to pursue after the SPC ends in 2027, to make the best of the product.

Step A: The scenario field analysis

Definition of the current state (year 2022)

Parameters	Current state
Market Share (MS)	2,5%
Financial (mEUR)	2020: 100 mEUR; 2021: 103 mEUR; 2022: 105 mEUR (current year forecast)
Legal	No risk

Source: Table 15 Definition of the current state (see subchapter 4.2, p. 43)

Step B: The scenario prognosis evaluation

1st step: Definition of the targeted state

Parameters	Current state (year 2022)	Targeted state
Market Share (MS)	2,5%	Same, increase
Financial (targeted revenue & possible investment)	2020: 100 mEUR; 2021: 103 mEUR; 2022: 105 mEUR (current year forecast)	Not lower than 90 mEUR p.a. for the prognosed years. Medium to low investment is acceptable.
Legal	Willingness to take legal risk	No risk

Source: Table 16 Definition of the targeted state (see subchapter 4.2, p. 44)

2nd step: Market share screening / filtering

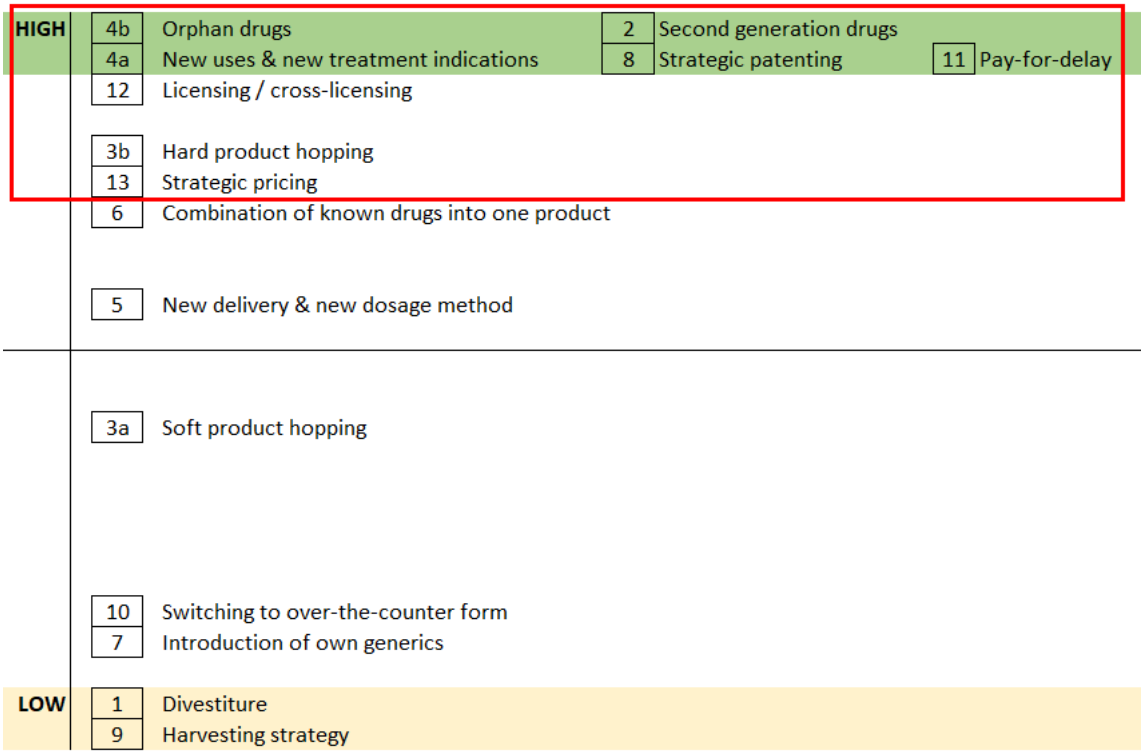
		Market Share Development		
Nr	**LCM Methods**	**Diminishing**	**Stable**	**Increasing**
2	Second generation drug		★	★
4	New uses & new treatment		★	★
5	New delivery method & new dosage		★	★
6	Combination of known drugs into one product		★	★
8	Strategic patenting		★	★
10	Swith to over-the-counter form		★	★
11	Pay-for-delay		★	

Source Table 17 LCM Methods Market Share Development (see subchapter 4.2, p. 46)

As a result of the filtering in the 2nd step the following LCM methods have remained: method number 2 (*second generation* drugs), 4 (*new uses & new treatment indication*), 5 (*new delivery method & new dosage*), 6 (*combination* of known drugs into one

product), 8 (*strategic* patenting), 10 (*switch to OTC* form), 11 (*pay-for-delay)* (see subchapter 3.2, p. 17).

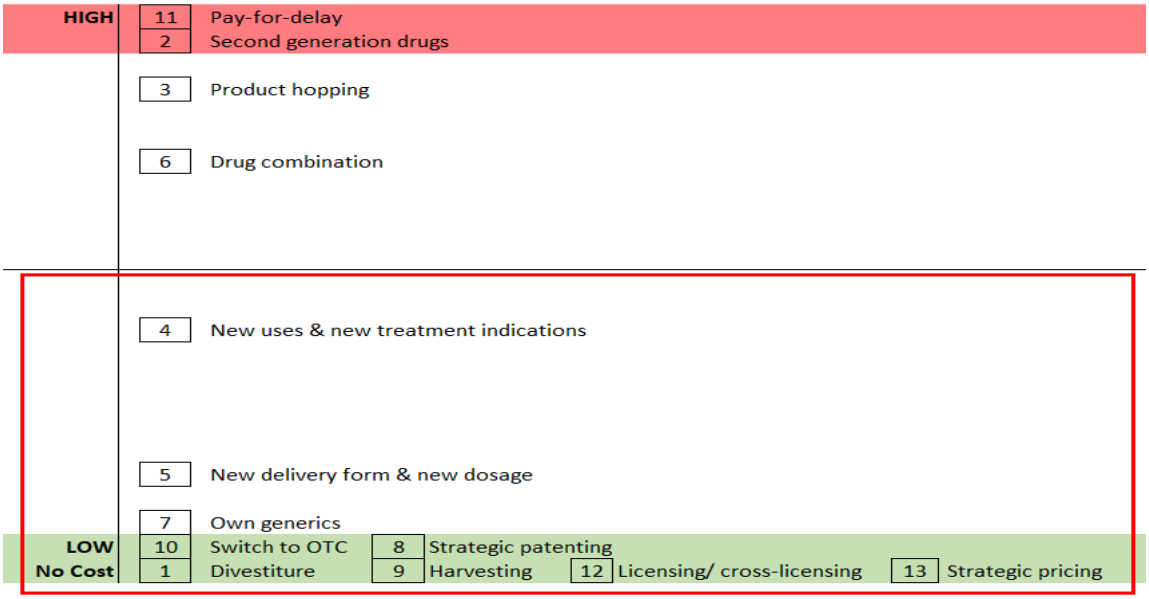
3rd step: Targeted revenue screening / filtering



Source: Figure 6 LCM safeguarding revenue after core patent expiration (see subchapter 4.2, p. 47)

Thus, as a result after the filtering in the 3rd step, the LCM methods remaining are 2 (*second generation* drugs), 4 (*new uses & new treatment indications*), 8 (*strategic patenting*), and 11 (*pay-for-delay*) (see subchapter 3.2, p. 17).

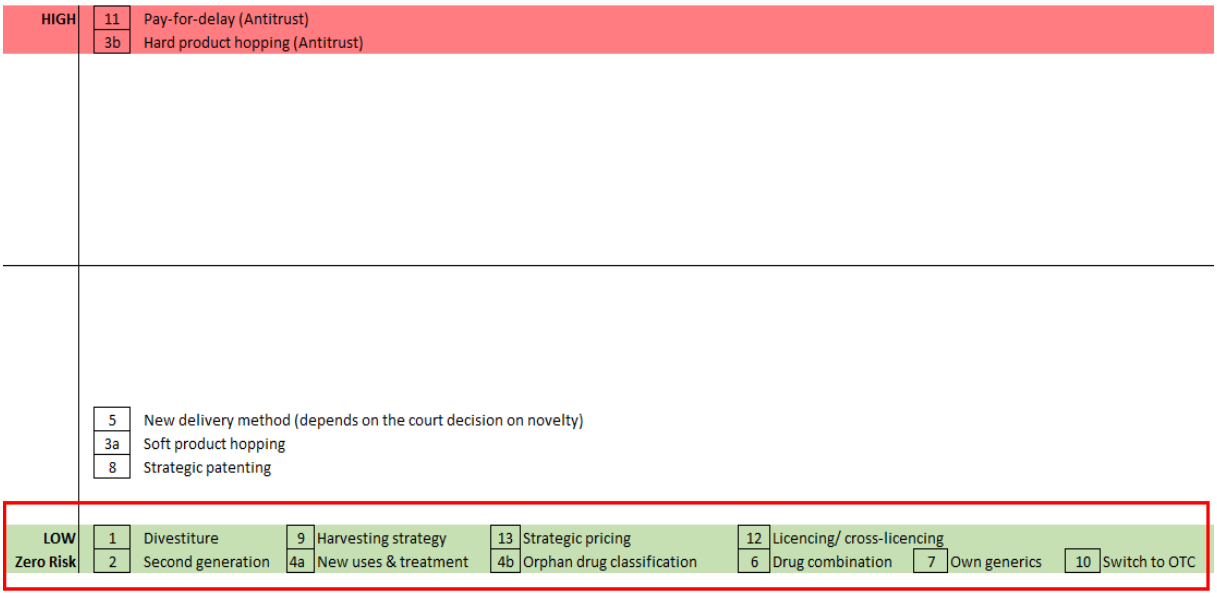
4th step: Possibility of investment filtering



Source: Figure 7 LCM investment level (see subchapter 4.2, p. 48)

As a result of the 4th filtering, the LCM methods remained are methods number 4 (*new uses & new treatment indications*) and 8 (*strategic* patenting) (see subchapter 3.2, p. 17).

5th step: Legal risk filtering



Source: Figure 8 LCM methods legal risk intensity (see subchapter 4.2, p. 49)

After the legal risk filtering, the LCM method remained is LCM method number 4 (*new use & new treatment area*) (see subchapter 3.2, p. 17).

6th step: Double-check

For the double-check the targeted state defined in step B is compared to the characteristics of the method listed in the concentrated table.

Parameters	Targeted state
Market Share (MS)	Same, increase
Financial (targeted revenue & possible investment)	Not lower than 90 mEUR p.a. for the prognosed years. Medium to low investment is acceptable.
Legal	No risk

Source: Table 16 Definition of the targeted state (see subchapter 4.3, p. 49)

LCM Nr	1	2	3a	3b	4	4a	4b	5	6	7	8	9	10	11	12	13
LCMs	Divestiture	Second generation drugs	Soft product hopping	Hard product hopping	Patenting of new uses	Pediatric area	Orphan drug	New delivery method	Drug combinations	Own generics	Strategic patenting	Harvesting	Switch to OTC	Pay-for-delay	Licensing/ cross-licensing	Strategic pricing
Add Patent (YRS)	0	7,5	4	4	7	0,5	7	3	5	0	15	0	0	0	0	0
Market Share Development	DIM	STABLE/INCR	DIM/STABLE	STABLE	STABLE/INCR	STABLE/INCR	STABLE/INCR	STABLE/INCR	STABLE/INCR	DIM/STABLE	STABLE/INCR	DIM/STABLE	STABLE/INCR	STABLE	DIM/STABLE	DIM/STABLE
Financial	LOW	HIGH	MEDIUM	UPPER-MED	HIGH	HIGH	VERY HIGH	MEDIUM	UPPER-MED	LOW	HIGH	LOW	LOW	HIGH	MEDIUM	MEDIUM
R&D	NO COST	MEDIUM	HIGH	HIGH	MEDIUM	MED-LOW	MED-LOW	MED-LOW	UPPER MED	NO COST	NO COST	NO COST	NO COST	NO COST	NO COST	NO COST
Legal	NO RISK	NO RISK	MED-LOW	HIGH	NO RISK	NO RISK	NO RISK	MED-LOW	NO RISK	NO RISK	MED-LOW	NO RISK	NO RISK	HIGH	LOW	LOW

*DIM = DIMINISHING
**INCR= INCREASING
***GREEN= POSITIVE IMPACT
****RED= NEGATIVE IMPACT

Source: Table 18 Concentrated table with LCM aspects, their appraisal (see subchapter 4.3, p. 56)

The double-check within both tables has confirmed the result: the remaining LCM method number 4 (*new use & new treatment* area) fits the targeted state which was set.

Step C: The scenario-building

As there is only one LCM method coming in question, then no further filtering is needed. However, it should be checked whether the chosen method really makes sense from the financial point of view. For such a check the following steps should be performed.

1st step: The definition of the number of years

The investigation needs to be done whether there are other areas of application for the drug, or it can be classified as orphan drug. In case of success, additional 7 years of patent protection can be achieved.

2nd step: The forecast of the revenue for each year

*Revenue (year x) = Volume (year x) * Price (year x)*

The assumption is, that within the further patent prolongation for additional 7 years the price and market demand remain constant and are same to 2022. Thus, for the timeframe of 2027 – 2034 the forecasted revenue would be 105 mEUR p.a.

3rd step: Prognosed DCF (at r = 10%)

DCF = 105/ 1,1 + 105/ 1,12+ 105/ 1,13+ 105/ 1,14+ 105/ 1,15+ 105/ 1,16+ 105/ 1,17= 95,45 + 86,78 + 78,89 + 71,92 + 65,22 + 59,32 + 53,88 = 511,46 mEUR

4th step: Investment needed

The R&D department gives an appraisal of cost related to the investigation whether a drug can be used in an additional area of treatment. According to the appraisal, the NPV would be calculated, and the decision would be met whether the LCM method makes sense from the NPV point of view or not.

5th step: Potential legal risk and cost

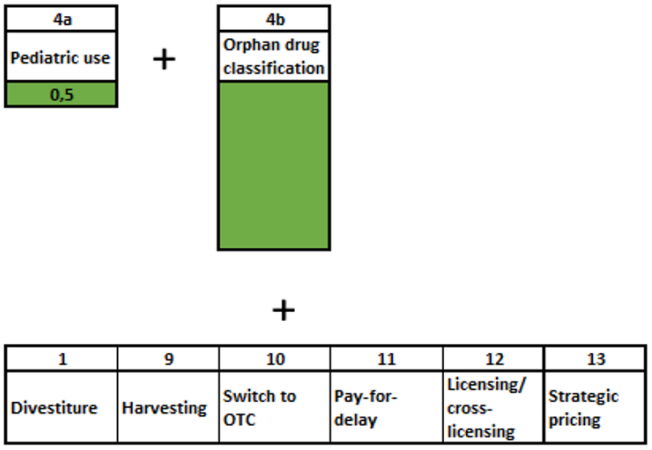
As the chosen method is legal, no potential legal risk is linked.

6th step: Final choice of the LCM method

As there is only one method meeting all targeted parameters, this step is omitted.

7th step: Possibility of subsequent combination of LCM methods

As depicted in Figure 10, the LCM method in favor of which the decision is met, can be combined with some another subsequent method.



Source: Figure 10 Possibility of combination of LCM strategies (see subchapter 4.2, p. 54)

According to the parameters given at the beginning in the definition of the targeted state, the possible LCM methods coming into consideration after application of *new uses & new treatment indication* (method number 4), would be patenting for *pediatric use* method (method number 4a) or *orphan drug* classification (method number 4b). If the targeted parameters change in the future, then other LCM methods could come into consideration as well (methods number 1, 9, 11, 12, 13).

8th step: Action plan

At final, the action plan is to be developed with alignment of responsibilities, allocation of budget and definition of timeframe.

NB In case if in the step B the filtering ends up without any LCM method, which could be taken into consideration, the management may either take it as it is or think its targeted state over.

5. Summary

The defense and advancement of innovation are of big importance for pharmaceutical companies. Companies-originators have a significant role in the healthcare system because they enable the invention of medicines, and thus serve bettering health of

society. The investments needed into R&D are very high. At the same time the cost of reproduction of drugs is low. That is why the will to bear big investments depends on the possibility to protect the inventions achieved with the help of investments into R&D (Bhat, 2005, p. 109). Such a protection is given by a patent (Bansal et al., 2009, p. 299).

The framework on patent protection is under constant development. At present the core patent gives a pharmaceutical company 20 years of patent protection. Since R&D process can take up to 12 years, this timeframe leaves pharmaceutical companies a limited opportunity to get the investment back through revenue generation. Consequently, it may happen that the company-originator does not get the return on investment needed before the core patent expiration. Therefore, pharmaceutical companies-originators look for ways to secure the high revenue generation on a longer term. LCM methods enable pharmaceutical companies in it (Bansal et al., 2009, p. 299).

Within the conducted research there are thirteen LCM methods identified, which can be used by a company to secure the profitability of a product also after core patent expiration. Each of the methods has its particularities and gives various modes in terms of financial benefit, market share development, legal risk. The complexity makes it difficult for management to meet the choice, which method would be the right one for a given product and a given company. It is of high importance for the management of a pharmaceutical company to have a systematic approach how to choose the LCM method most suitable for a given product and company. Especially in view of BJR the decision should have a systematic approach and scientific basis (see Appendix D on BJR law text).

The assessment matrix developed in this master thesis bases on scenario formulation approach, as well as Game theory and Bernoulli principle, using market share, financial and legal parameters. It gives management a supporting tool for the conduction of the choice process on the options of actions, suitable and applicable for a given medicine and pharmaceutical company-originator after core patent expiration.

6. Limitations: the morality dilemma

The matrix developed in this master thesis does not consider such parameter as “morality” or “social responsibility”.

During the literature research the question of “morality” of LCM has been raised by various researchers. Thus, Abbas (2019) addresses the delays of the entrance of affordable pharmaceutical products into the market caused by application of LCM (p. 53). Another angle of the “morality” discussion is about “duty to provide essential lifesaving drugs” (Huebner, 2014, p. 501). Belt (2013) addresses the issue of accessibility of patented medicines (p. 87). Shadlen et al. (2020) enforce the argumentation with an example of difficulties in accessibility to HIV/AIDs treating drugs because of their remaining high prices within the HIV/AIDs pandemic in South Afrika in 1990s-2000s (p. 76). The argumentation goes in hand with the general question whether one should have an “exclusive right to his or her ideas, and thus, the products of those ideas?”, or whether a one-off compensation to the inventor should be sufficient (Gewertz and Amado, 2004, p. 295). Same in view of the Business Judgement Rule, focusing on the claims of the society towards business companies (Willen, 2019, p. 7).

The counterargument, supporting the use of LCM, asserts that the more a pharmaceutical company is certain to be able to use the full potential of its invention and intellectual property rights, the more it is willing “to maintain the cycle of innovation for the benefit of public health” (Bansal et al., 2009, p. 301). Moreover, the primary target of business is its profitability. “Milton Friedman’s assertion that “[t]he social responsibility of business is to increase its profits” is hardly fashionable today, but that does not make it wrong” (Boscheck, 2015, p. 223).

Additionally, the topic of product discontinuation and to a certain extent linked to it problem of drug shortage, highlight the positive impact of LCM, through which the drug presence on the market is assured. The decision on discontinuation of a medicine is taken by management of a pharmaceutical company and bases among others on the arguments of low sales and not sufficiently high profit margin. Thus, in the USA in 2014 around 13% of drug shortage was due to the drug discontinuation (Dill and Ahn, 2014, pp. 1405-1408). Viewing the therapeutic consequences coming out of the discontinuation of medicines, and the fact that LCM serves the retention of the

medicines on the market, the question of ethical aspect of LCM appears in a different light.

The matrix would be more complete if the “morality” or “social responsibility” parameter would be implemented. This is not done due to complexity of the topic and thus its thorough investigation would surpass the volume frames of a master thesis.

7. Outlook

The role of pharmaceutical industry is tremendous both in terms of its impact on health system, as well as on economics worldwide. The LCM methods have a significant role in retention of profitability and thus security of longevity of pharmaceutical companies. The developed decision matrix aims to ensure that the most suitable LCM method, fulfilling the company needs, is chosen. However, in view of increasing will of regulation of pharmaceutical industry from the side of governments, the strengthening of social cost aspect discussion, as well as the increase of liability of management for decisions taken, the moral aspect consideration gets more and more present (Kim & Scialli, 2011, p. 1; Xie, 2021, p. 20; Willen, 2019, p. 7). Thus, as a next step in the development of the matrix the morality aspect should be added as a parameter to accomplish the assessment matrix, developed in this master thesis.

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V. Appendix

Appendix A

List of Member States of Paris Convention

Participant
Algeria
Argentina
Australia
Austria
Bahamas
Belgium
Benin
Brazil
Bulgaria
Burundi
Cameroon
Canada
Central African Republic
Ceylon
Chad
Congo
Congo (Brazzaville)
Croatia
Cuba
Cyprus
Czech Republic
Czechoslovakia
Dahomey
Denmark
Dominican Republic
Egypt
Faroe Islands
Federal Republic of Germany
Finland
France
Gabon
German Democratic Republic
Ghana
Greece
Haiti
Holy See
Hungary
Iceland
Indonesia

Iran
Iraq
Ireland
Israel
Italy
Ivory Coast
Japan
Jordan
Kenya
Laos
Lebanon
Libyan Arab Jamahiriya
Liechtenstein
Luxembourg
Madagascar
Malawi
Malta
Mauritania
Mauritius
Mexico
Monaco
Morocco
Netherlands
New Zealand
Niger
Nigeria
Norway
Philippines
Poland
Portugal
Romania
Russian Federation
San Marino
Senegal
South Africa
Spain
Sri Lanka
Suriname
Sweden
Switzerland
Syria
Syrian Arab Republic
Tanzania
Togo

Trinidad and Tobago
Tunisia
Turkey
Uganda
Union of Soviet Socialist Republics
United Arab Republic
United Kingdom of Great Britain and Northern Ireland
United Republic of Cameroon
United States of America
Upper Volta
Uruguay
Vatican City State
Viet Nam
Yugoslavia (Socialist Federal Republic of)
Zaire
Zambia

Source: World Intellectual Property Organization, 1972

Appendix B

Table 1: Revenue losses following patent expiration and generic drug entry[11–14]

Brand name	Manufacturer	US sale prepatent expiration (in US$ million)	US sale postpatent expiration (in US $ million)	Year expired
Claritin	Schering-Plough	>3	370	2002
Prozac	Eli Lily	>2.9	480	2001
Pepcid	Merck	755	110	2000

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Source: Gupta, 2010, pp. 2—3

Appendix C

The patent registration fees in Germany

Rechercheantrag (freiwillig)	300,00 €
Elektronische Anmeldung	40,00 € (inklusive 10 Patentansprüche, 20,00 € für jeden weiteren)
Postalische Anmeldung	60,00 € (inklusive 10 Patentansprüche, 30,00 € für jeden weiteren)
Prüfungsgebühr	150,00 € (nach vorherigem Rechercheantrag) 350,00 € (ohne vorherigen Prüfungsantrag)

The patent registration fees in European Union

Rechercheantrag	1.300,00 €
Elektronische Anmeldung	120,00 € (inklusive 15 Patentansprüche, 235,00 € für jeden weiteren)
Postalische Anmeldung	210,00 € (inklusive 15 Patentansprüche, 235,00 € für jeden weiteren)
Benennung der Staaten, in denen Sie die Erfindung schützen möchten	585,00 €
Prüfungsgebühr	1.635,00 €
Erteilung des Patents	925,00 €
Veröffentlichung des Patents	75,00 €

The patent fees for consecutive years in Germany and in European Union

Jahr nach Anmeldung	Jahresgebühr für das deutsche Patent	Jahresgebühr für das europäische Patent
3.	70,00 €	470,00 €
5.	90,00 €	820,00 €
10.	350,00 €	1.575,00 €
15.	1.060,00 €	1.575,00 €
20.	1.940,00 €	1.575,00 €

Source: Bauer, 2022

Appendix D

Business Judgement Rule

Abs. 1 Satz 2 des § 93 AktG

§ 93 AktG Sorgfaltspflicht und Verantwortlichkeit der Vorstandsmitglieder

(1) 1Die Vorstandsmitglieder haben bei ihrer Geschäftsführung die Sorgfalt eines ordentlichen und gewissenhaften Geschäftsleiters anzuwenden. 2Eine Pflichtverletzung liegt nicht vor, wenn das Vorstandsmitglied bei einer unternehmerischen Entscheidung vernünftigerweise annehmen durfte, auf der Grundlage angemessener Information zum Wohle der Gesellschaft zu handeln. 3Über vertrauliche Angaben und Geheimnisse der Gesellschaft, namentlich Betriebs- oder Geschäftsgeheimnisse, die den Vorstandsmitgliedern durch ihre Tätigkeit im Vorstand bekanntgeworden sind, haben sie Stillschweigen zu bewahren.
(2) 1Vorstandsmitglieder, die ihre Pflichten verletzen, sind der Gesellschaft zum Ersatz des daraus entstehenden Schadens als Gesamtschuldner verpflichtet. 2Ist streitig, ob sie die Sorgfalt eines ordentlichen und gewissenhaften Geschäftsleiters angewandt haben, so trifft sie die Beweislast. 3Schließt die Gesellschaft eine Versicherung zur Absicherung eines Vorstandsmitglieds gegen Risiken aus dessen beruflicher Tätigkeit für die Gesellschaft ab, ist ein Selbstbehalt von mindestens 10 Prozent des Schadens bis mindestens zur Höhe des Eineinhalbfachen der festen jährlichen Vergütung des Vorstandsmitglieds vorzusehen.

(3) Die Vorstandsmitglieder sind namentlich zum Ersatz verpflichtet, wenn entgegen diesem Gesetz

1. Einlagen an die Aktionäre zurückgewährt werden,
2. den Aktionären Zinsen oder Gewinnanteile gezahlt werden,
3. eigene Aktien der Gesellschaft oder einer anderen Gesellschaft gezeichnet, erworben, als Pfand genommen oder eingezogen werden,
4. Aktien vor der vollen Leistung des Ausgabebetrags ausgegeben werden,
5. Gesellschaftsvermögen verteilt wird,
6. (aufgehoben)
7. Vergütungen an Aufsichtsratsmitglieder gewährt werden,
8. Kredit gewährt wird,

9. bei der bedingten Kapitalerhöhung außerhalb des festgesetzten Zwecks oder vor der vollen Leistung des Gegenwerts Bezugsaktien ausgegeben werden.

(4) 1Der Gesellschaft gegenüber tritt die Ersatzpflicht nicht ein, wenn die Handlung auf einem gesetzmäßigen Beschluß der Hauptversammlung beruht. 2Dadurch, daß der Aufsichtsrat die Handlung gebilligt hat, wird die Ersatzpflicht nicht ausgeschlossen. 3Die Gesellschaft kann erst drei Jahre nach der Entstehung des Anspruchs und nur dann auf Ersatzansprüche verzichten oder sich über sie vergleichen, wenn die Hauptversammlung zustimmt und nicht eine Minderheit, deren Anteile zusammen den zehnten Teil des Grundkapitals erreichen, zur Niederschrift Widerspruch erhebt. 4Die zeitliche Beschränkung gilt nicht, wenn der Ersatzpflichtige zahlungsunfähig ist und sich zur Abwendung des Insolvenzverfahrens mit seinen Gläubigern vergleicht oder wenn die Ersatzpflicht in einem Insolvenzplan geregelt wird.

(5) 1Der Ersatzanspruch der Gesellschaft kann auch von den Gläubigern der Gesellschaft geltend gemacht werden, soweit sie von dieser keine Befriedigung erlangen können. 2Dies gilt jedoch in anderen Fällen als denen des Absatzes 3 nur dann, wenn die Vorstandsmitglieder die Sorgfalt eines ordentlichen und gewissenhaften Geschäftsleiters gröblich verletzt haben; Absatz 2 Satz 2 gilt sinngemäß. 3Den Gläubigern gegenüber wird die Ersatzpflicht weder durch einen Verzicht oder Vergleich der Gesellschaft noch dadurch aufgehoben, daß die Handlung auf einem Beschluß der Hauptversammlung beruht. 4Ist über das Vermögen der Gesellschaft das Insolvenzverfahren eröffnet, so übt während dessen Dauer der Insolvenzverwalter oder der Sachwalter das Recht der Gläubiger gegen die Vorstandsmitglieder aus.

(6) Die Ansprüche aus diesen Vorschriften verjähren bei Gesellschaften, die zum Zeitpunkt der Pflichtverletzung börsennotiert sind, in zehn Jahren, bei anderen Gesellschaften in fünf Jahren.

Source: Buzer.de, 2022

VI. Declaration of originality

I hereby declare that this master thesis and the work reported herein was composed by and originated entirely from me. Information derived from published and unpublished work of other has been acknowledged in the text and references are given in the list of references.

Place, Date	**Signature**
Hamburg, 29.08.2023	[redacted]

Publication at the HAW library

Herewith I agree with the publication at the HAW library catalogue.

Place, Date	**Signature**
Hamburg, 29.08.2023