Extracting Product Opportunities from Intellectual Property Portfolios: From Patent to Product Idea

by

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B.S. Engineering, Massachusetts Institute of Technology, 2009

Submitted to the MIT Sloan School of Management and the Mechanical Engineering Department in Partial Fulfillment of the Requirements for the Degrees of

Master of Business Administration and
Master of Science in Mechanical Engineering

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Abstract

Companies and research institutes maintain large intellectual property portfolios, which are considered company assets and require significant investments to maintain. This thesis looks at the potential to extract value from such portfolios through new product development to offset this capital investment. Traditionally the IP protects existing products or excludes competitors from entering a given market. Alternatively this process looks to move from intellectual property (IP) to product ideas (PI), hereafter referred to as the IP2PI process.

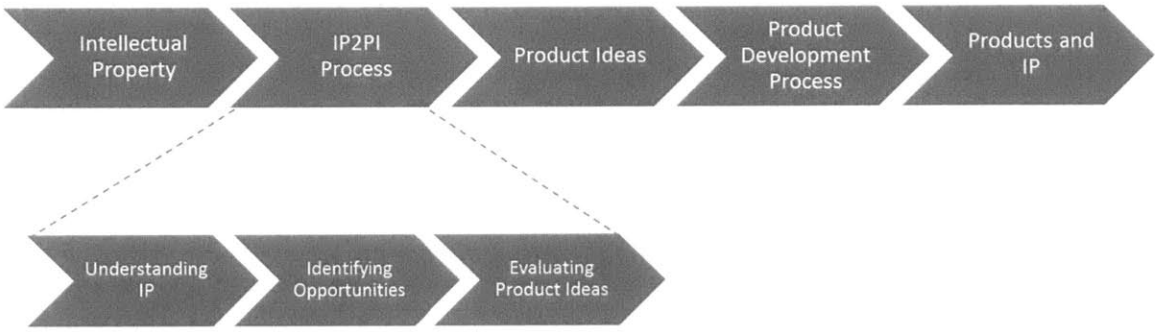

Figure 1: IP2PI Process Overview

As outlined in Figure 1 the IP2PI process starts with intellectual property as the main input. Next the IP2PI process itself consists of three steps:

- Understanding the IP and key technologies included therein,
- Identifying market opportunities and applications of the technologies, and
- Evaluating product ideas based on market needs and other criteria.

The outputs of the process are evaluated product ideas which can then serve as the inputs to product development processes.

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At MIT I would like to thank my academic advisors and the LGO program office. In particular my advisors, Jonathan Fleming and Warren Seering, both provided important advice, feedback and support throughout the internship. And of course I want to thank them both for their incredible responsiveness during the thesis writing process.

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And finally, I want to thank friends and classmates for bearing with me as I navigated this project without being able to share any of the interesting details.

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Glossary

These terms may not be explicitly defined in the text but are useful in the context of the research presented.

Definitions

(Fuzzy) Front End – Product idea generation phase of product development, further definitions and discussion can be found in Chapter 1.2.2Product Development Process

Intellectual Property – Patents, trademarks and copyrights held by a company

Leaders for Global Operations – an MIT graduate dual-degree program between the School of Engineering and the Sloan School of Management with a focus on operations; formerly known as Leaders for Manufacturing

Abbreviations

IP	Intellectual Property
IP2PI	Intellectual Property to Product Idea (when referring to the process)
LGO	Leaders for Global Operations
NPD	New Product Development
PI	Product Idea
USPTO	US Patent and Trademark Office

1 Introduction

Intellectual property is an ingrained part of technology businesses today. The US Patent and Trademark Office began in 1871 as the Patent and Trademark Resource Center Program[1] and the number of patents has grown steadily ever since. The USPTO granted 302,948 patents in 2013, more than a six-fold increase from 1963.[2] These patents are filed by individuals, as well as by public and private organizations.

Universities, companies and other institutions with extensive research and development organizations can file hundreds, even thousands, of patents every year. Additionally a new breed of organization has developed based on the acquisition and maintenance of extensive portfolios (Feldman and Ewing 2012). All such activities point towards the importance and value of intellectual property portfolios.

The portfolios are considered company assets, which indicates the positive values associated with them. The goal then is to extract value. In many cases the intellectual property protection is sought for a technology developed for a specific application. In addition to filing for patents companies increasingly acquire patents from outside sources, such as an academic institution or other company, and companies can then look to extract additional value from the acquired assets. Patents can be used to protect a product or market or to exclude others from an opportunity. This thesis looks at an alternative option of extracting value from acquired patents through new product development.

[1] 02/24/2014: http://www.uspto.gov/products/library/ptdl/background/
[2] 02/24/2014: http://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm

While companies use a variety of often proprietary product development processes, there are many commonalities. Depending on the source, product development models can range from three to thirteen stages (Tidd and Bodley 2002). Most models, however, have the following common phases seen in Figure 2.

Figure 2: Product Development Phases (Ulrich and Eppinger 2012)

The focus of this thesis is on idea generation in Phase 0, sometimes referred to as the front end process. There are a wide variety of definitions for the front end process, which are outlined briefly in Chapter 1.2.2 Product Development Process. A common element remains the product idea on which the future developments are based. As one option to extract value from IP portfolios, this thesis examines the opportunity to go from intellectual property to product ideas.

1.1 General Context

Project Context

The research for this project was conducted during an LGO internship at Sanofi. The internship focused on the development of a process to extract value from the extensive IP portfolio maintained by the company. In addition to the investment in research and development or the acquisitions that build the portfolio, there are also considerable fees involved in maintaining it. While basic filing fees run $280, the maintenance fees for that same patent will run at least $12,600 for the life of the patent.[3] Therefore there must be sufficient justification for the fees, time and effort necessary to maintain every patent in the portfolio. In addition to the

[3] US filing schedule; 02/24/2014: http://www.uspto.gov/web/offices/ac/qs/ope/fee010114.htm

traditional value propositions of the IP, such as protection of existing products and processes, Sanofi expressed interest in extracting value through product development, which became the described project.

The acquired Pelikan Technologies portfolio was selected as an example, since its manageable size and contained nature made it a good starting point for an outsider, who was otherwise not familiar with Sanofi's portfolio. The portfolio represented blood glucose monitoring and measurement, sample acquisition and lancing technologies developed for the Pelikan Sun electronic lancing device and contained approximately 350 patents, which were acquired after Pelikan Technologies' bankruptcy in 2011.

Company Context

Sanofi is a worldwide pharmaceutical company with headquarters located in Paris, France. It is widely known for its diabetes products, in particular a long-acting human insulin analog called Lantus. Sanofi is also active in the oncology, human vaccines, rare diseases, animal health and consumer healthcare areas. Allegra, for example, is a Sanofi brand over-the-counter allergy medication offered in America.

Sanofi's diverse product portfolio can in part be attributed to its history. Sanofi developed from a series of mergers and acquisitions over several centuries. Individual labs can trace their history as far back as 1718, with many being founded in the second half of the 1800s. The name Sanofi itself dates to 1973. Figure 3 gives an overview of some of the activities that led to Sanofi in its current form. Under CEO Chris Viehbacher, the company has continued to diversify from a pharmaceutical company to a healthcare company (Torsoli 2013), which includes medical

devices such as pens and other drug delivery devices. Sanofi launched its first blood glucose meters in April 2011.[4]

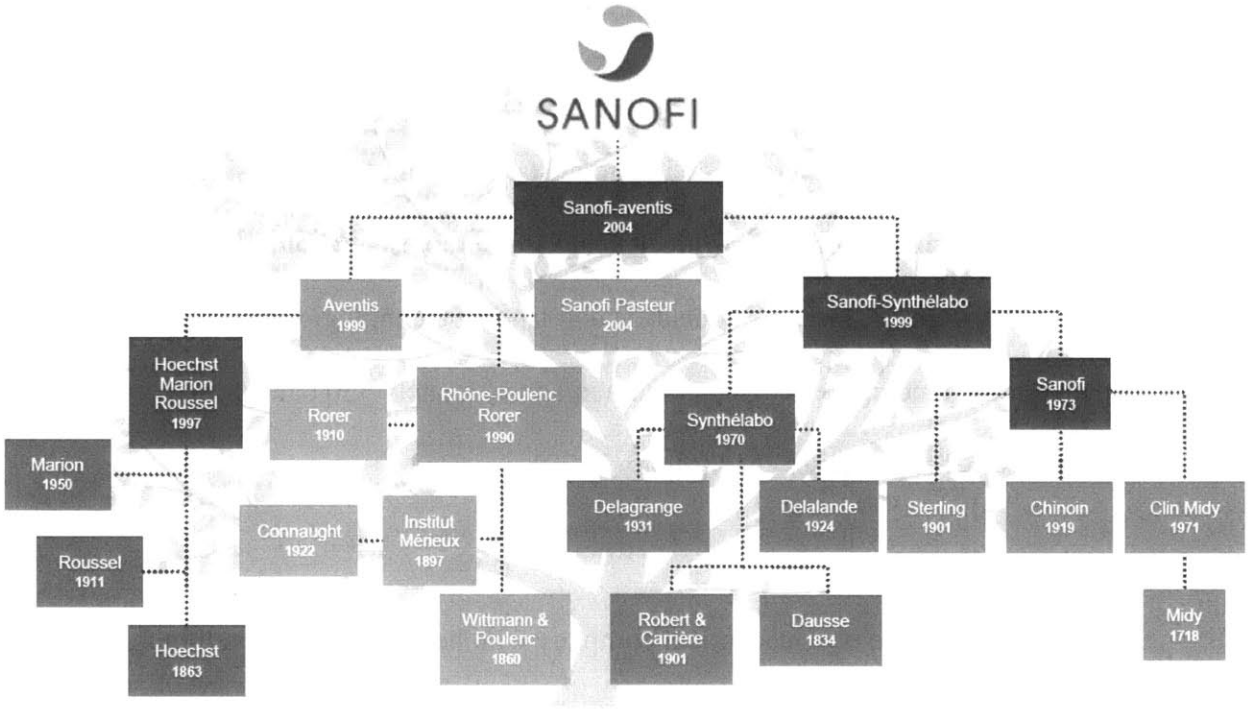

Figure 3: History of Sanofi[5]

Industry Context

Intellectual property is a driving factor in the pharmaceutical industry. After the cost and risk of developing a drug and getting the appropriate approvals, for example from the FDA in the USA, patents protect the investment and secure the market for the drug throughout their life time. While patents disclose the details of the drug and the production process, they prevent anyone from releasing a generic during their lifetime. Upon expiration of a patent other companies are able to enter the respective market and often do so with less expensive generic

[4] 02/24/2014: http://www.bgstar.com/web/news/innovative_bgstar
[5] 02/24/2014: http://en.sanofi.com/Images/28881_History_of_Sanofi.pdf

versions of the pharmaceutical. Due to this market dynamic, pharmaceutical companies have always been focused on the details of their patent portfolios.

The effects of expiring patents can vary based on the details of the drug and in particular its production process. The more complicated and variable the production process, the more difficult it is for outside companies to replicate the clinical trials necessary to get approval to sell. Unfortunately Sanofi's maturing pharmaceutical product portfolio is approaching many patent expiration dates[6]. Like many other participants in the pharmaceutical industry, Sanofi has an increased focus on diversification. This includes expanded presence in emerging markets, diversified product categories, and research and development.

1.2 Background Research

1.2.1 Importance of IP

As referenced in the Project Context section, IP serves a multitude of functions. The categorization of patents can be conducted in multiple ways, all with the goal of maintaining competitive advantages. To this extent IP portfolios are maintained by a variety of organizations, including companies, universities and institutions. Intangible assets are becoming a driving force in the valuation of a company, with some experts estimating that up to 65% of a company's worth is derived from items such as patents, trademarks, trade secrets and brand recognition (Innography 2014).

[6] 02/24/2014: Business Monitor International, Global Company Strategy – Sanofi (from 21 August 2013)

While most companies protect the exact nature of their intellectual property activities, public disclosures provide a window into their meaning. As an example, Amazon.com describes its view on intellectual property as follows (Quote 1):

> *"We regard our trademarks, service marks, copyrights, patents, domain names, trade dress, trade secrets, proprietary technologies, and similar intellectual property as critical to our success, and we rely on trademark, copyright, and patent law, trade-secret protection, and confidentiality and/or license agreements with our employees, customers, partners, and others to protect our proprietary rights."*

Quote 1: Intellectual Property Overview from Amazon.com Annual Report 2012[7]

Companies seek intellectual property to protect innovations, which can be used internally or licensed externally. In their 2012 annual report IBM describes their balanced strategy of pursuing intellectual property not exclusively for use in IBM products, but also for products of licensees.[8] This balanced approach also extends to the goal of not being entirely dependent on one particular patent or license at any given time. The accumulated intellectual property is carried as an asset on the balance sheets and can serve as a source of income. In 2012 the sale or transfer of IP and the licensing fees generated $575 million for Intel.[9]

As mentioned above, the opportunity to generate income through intellectual property is not limited to manufacturing companies. Research institutions such as the Massachusetts Institute of Technology are also important players in this arena. The MIT Technology Licensing Office is responsible for all intellectual property generated in conjunction with the institute. As shown in Table 1, 305 patents were filed in the 2012 fiscal year alone.

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[7] 02/24/2014: http://phx.corporate-ir.net/phoenix.zhtml?c=97664&p=irol-reportsannual
[8] 02/24/2014: http://www.ibm.com/annualreport/2012/bin/assets/2012_ibm_annual.pdf
[9] 02/24/2014: http://www.ibm.com/annualreport/2012/bin/assets/2012_ibm_annual.pdf

Total Number of Invention Disclosures	694
Number of U.S. Patents Filed (including all non-provisional applications: ordinary, priority, continuation, divisional and C.I.P.)	305
Number of U.S. Patents Issued	199
Number of Licenses Granted (not including trademarks and end-use software)	81
Number of Trademark Licenses Granted	139
Number of Software End-Use Licenses Granted	TBD
Number of Options Granted (not including options as part of research agreements)	26
Number of Companies Started venture capitalized and/or with minimum of $500K of other funding)	16

Table 1: MIT Technology Licensing Office Statistics for Fiscal Year 2012[10]

The MIT Technology Licensing Office not only manages the filing but also maintains an ownership stake. The IP portfolio of MIT is a source of income for the institute, which totaled $147.5 million in 2012.

Unfortunately there are also costs associated with managing the portfolio. Starting with the basic filing fee in the US of $280, there are maintenance fees which can amount to $12,600 over the life of the patent. Additionally patents must be filed in every country where protection is desired. Each country operates an independent process and sets its own fees. As shown in Table 2, the fees vary greatly and can add up quickly. A single patent filed in the four listed regions would require $70,012 to be maintained throughout its lifespan. The cost associated with a patent portfolio can therefore grow exponentially when considering that large organizations can file anywhere from 100 to over 2,000 patents in a year.

[10] 02/24/2014: http://web.mit.edu/tlo/www/about/office_statistics.html

Table 2: Filing and Maintenance Fees by Country

	US[11]	EPC[12]	Japan[13]	China[14]
Basic Filing	$ 280	€ 115	¥ 15,000	¥ 950
Maintenance	$ 12,600	€ 22,860	¥ 1,078,000	¥ 88,300
	Conversion to US Dollar[15]			
Basic Filing	$ 280	$ 159	$ 147	$ 155
Maintenance	$ 12,600	$ 31,698	$ 10,587	$ 14,386

In addition to the filing and maintenance costs and the personnel costs, there are also litigation fees associated with protecting patents. After filing a patent with the USPTO, the burden falls on the owner of the patent to monitor for potential infringement and to react if necessary. As an example, MIT spend a total of $16.5 million on patent related activities in fiscal year 2012. Ideally the expenditures are significantly lower than the income generated and value of the assets generated in order to justify the proposition.

While intellectual property is generally considered an asset, there are also risks associated with the portfolios. Protection varies by country, and the company must pursue the enforcement of patent law independently. Companies are at risk of someone infringing on their rights and being required to pursue court actions to protect themselves. Companies also risk infringing on the IP of others (intentionally or not) at which point they can also become the target of legal action.

To manage the risks and evaluate the costs, companies and institutions have developed a number of internal mechanisms to review their portfolios for relevance, redundancies and

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[11] 03/14/2014: http://www.uspto.gov/web/offices/ac/qs/ope/fee010114.htm
[12] European Patent Convention; 03/14/2014: http://documents.epo.org/projects/babylon/eponet.nsf/0/6925584FF2F2E81AC12579BF003CF727/$File/schedule_of_fees_and_expenses_20120401.pdf
[13] 03/14/2014: http://www.jpo.go.jp/tetuzuki_e/ryoukin_e/ryokine.htm
[14] 03/14/2014: http://www.afdip.com/practices%20areas/fees.pdf
[15] Currency conversions calculated using rates on 3/14/2014

opportunities. Often internal review meetings are used to discuss individual patents or patent families, especially before maintenance fees are due. In addition to the discussion surrounding the use of patents to protect existing products, this process aims to provide an additional opportunity to extract new product ideas out of the patent portfolio.

1.2.2 Product Development Process

There are many definitions of the product development process. In addition to the different academic models, individual companies will also tailor the process to their specific products and culture. As indicated in the Chapter 1, the number of steps can vary greatly. And beyond the number of sections, the content can be reshuffled as well. In comparison to the seven steps outlined in Figure 2: Product Development Phases (Ulrich and Eppinger 2012), the following seven steps focus more on business analysis and testing (Page 1993):

- Concept Search
- Concept Screening
- Concept Testing
- Business Analysis
- Product Development
- Product Use Testing, Field Testing and/or Market Testing
- Commercialization

In similar fashion, the front end of the New Product Development (NPD) process can be defined in multiple ways. Some describe it as all activities prior to the start of formal NPD-projects (Nobelius and Trygg 2002). Similarly the front end can be defined as the period from the initial identification of an idea to the firm's decision whether or not to invest (Kim and Wilemon 2002). In that context, the front end of NPD is also described as being "fuzzy," a term meant to indicate that this stage is intrinsically non-routine, dynamic and uncertain. There are

also a variety of definitions for the front end process which provide more structure. While the definition in Quote 2 is similar, the process in Figure 4 outlines the details better.

> *"The fuzzy front end [...] is considered to be the first stage of the new product development process and roughly covers the periods from the generation of an idea to its approval for development or termination."*

Quote 2: Definition of the Fuzzy Front End (Jetter 2003)

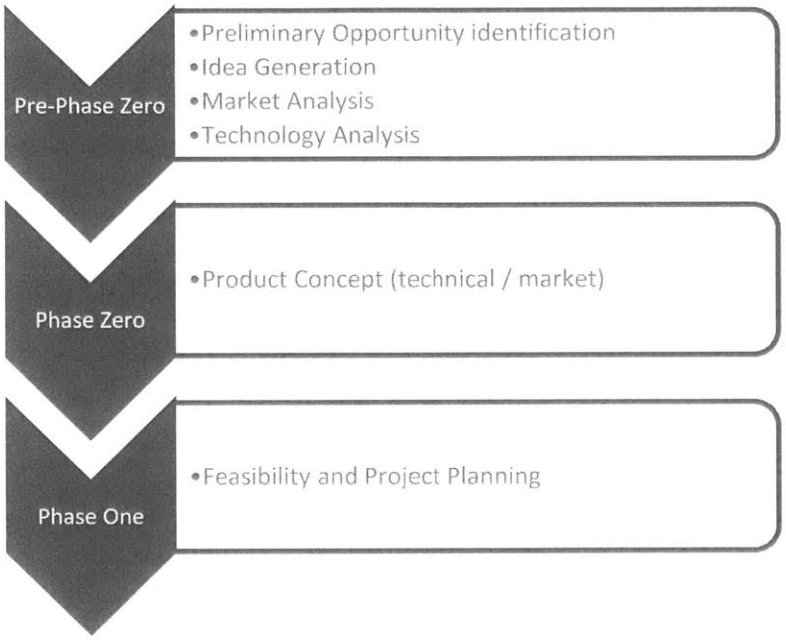

Figure 4: Front End Activities (Jetter 2003)

Also called the predevelopment stage, the front end covers the same general steps as outlined in Figure 4. An attempt to describe the predevelopment process in three stages leads to: Idea Generation, Product Definition, Project Evaluation (Murphy and Kumar 1997). In contrast, the initial product development process references in Figure 2: Product Development Phases (Ulrich and Eppinger 2012) leads to the incorporation of the front end into the concept development stage (Figure 5).

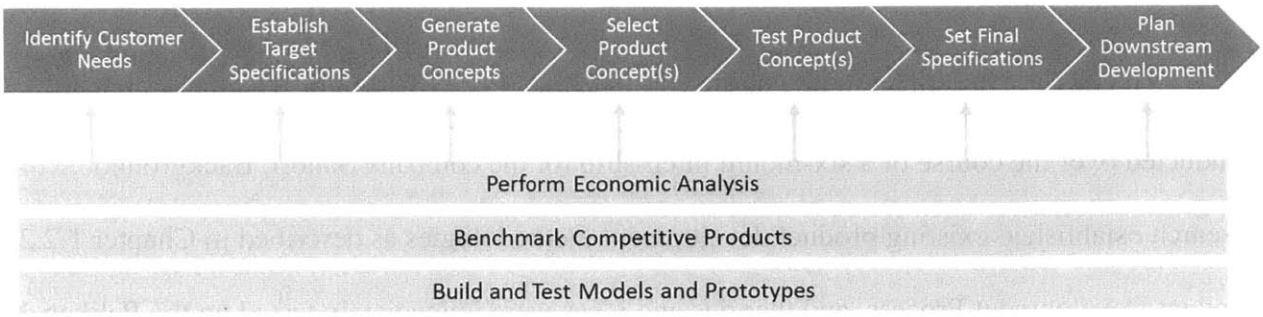

Figure 5: Front End Activities Comprising the Concept Development Phase (Ulrich and Eppinger 2012)

The models for the (fuzzy) front end intend to counteract the uncertainty described earlier. To account for the inherent uncertainty, managerial flexibility is considered preferable in the start-up phase to a set front end process (Nobelius and Trygg 2002). While there is variation in models and definitions examined here, there is also significant overlap between the models, which indicates that some phases could be of particular importance in the front end process. In all their vagueness "idea generation" and "concept evaluation/selection" are common threads throughout and play a significant role in the (fuzzy) front end.

1.3 Problem Statement

Because of the importance of IP, the desire existed to look into another option for extracting value. The focus was narrowed to identifying product opportunities which could lead to new products, additional market share and increased revenue. The goal was to develop a process to generate product ideas from IP portfolios. The process should be adaptable for various types of portfolios and should fit into a given company's existing product development process.

1.4 Research Methods

The process described in this thesis was developed as a case study. The research was conducted over the course of a six-month internship for the company Sanofi. Background research established existing product development methodologies as described in Chapter 1.2.2 Product Development Process, and theories and ideas were immediately tested on the Pelikan portfolio. To that extent this process has only been attempted once, leaving this body of work as an example of a process from intellectual property to product idea.

The research was conducted through an iterative process. After a brief period of research, the theory would be tested on the given example. Reflection on the process and results would form the basis for research into an alternative (if the initial approach failed) or into the next step (if an acceptable result was achieved). This iterative process was conducted on the example portfolio described in the Project Context.

The Pelikan portfolio is a group of patents and applications, which had all been acquired at the same time from a single source. The portfolio was reviewed as a separate entity from any potentially related content in extended Sanofi patent portfolio. The entire process development was constrained to a six-month period, which limited the number of patents which could be included in the example. The manageable size of the Pelikan portfolio allowed an individual to familiarize themselves with it in less than two months.

As stated, the process discussed in this thesis was developed based on an existing IP portfolio owned by Sanofi. The patents from that portfolio will be used as examples throughout, but we will not discuss the results due to confidentiality limitations. Examples are limited to

discussion of the interaction with patents and will be excluded from later sections regarding product ideas and strategy.

1.5 Process Overview

This research focused on extracting value from patent portfolios through product development and led to the development of a process to leverage intellectual property for product ideas. It is referred to as the Intellectual Property to Product Idea Process or IP2PI process.

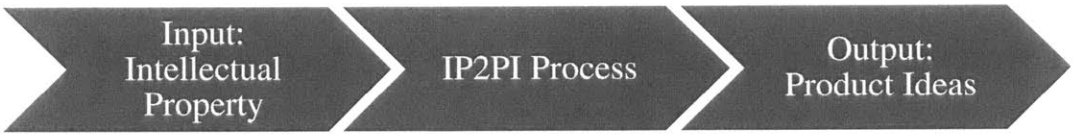

Figure 6: IP2PI Input and Output

Intellectual property is the input to the IP2PI process, which in turn generates product ideas as the corresponding output (Figure 6). The actual process consists of three steps as outlined in Figure 7. While the IP2PI process will be discussed in more detail in Chapter 2 Extracting Product Opportunities from Intellectual Property Portfolios, the following provides a brief overview.

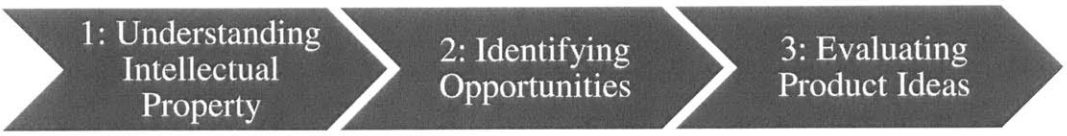

Figure 7: IP2PI Process Steps

The goal of the first stage of the process is to develop a thorough understanding of the IP which is to be evaluated. This can have various levels of involvement depending on previous knowledge. The reviewer must go beyond a quick overview, since the process depends on an understanding of the general topics and technologies in order to expand the product applications.

The underlying technologies categorized and evaluated in Step 1 serve as the basis for the brainstorming activities in Step 2. When attempting to identify opportunities, the goal is to look beyond the initial product application of the patents, which is why a thorough understanding is so important. Step 2 focuses on creativity and maximizing options, which will then be evaluated in Step 3. This step refocuses the product ideas and screens for factors such as technology risks, expected market size and development costs. The goal is, after Step 3, to have a subset of product ideas that meet the starting criteria for the company's product development process.

2 Extracting Product Opportunities from Intellectual Property Portfolios

As described in the previous section, the IP2PI process consists of three distinct steps, which will each be discussed in more detail in the subsequent sections.

2.1 Understanding the IP and Key Technologies

The first step of the IP2PI process focuses on gaining a working understanding of the existing IP portfolio to serve as the basis for the generation of product ideas. The extent to which the following activities are completed should be adjusted to match the level of existing familiarity with the portfolio. The goal of the section is to develop an overview of all technologies included in the portfolio. An outside reviewer, who is otherwise unfamiliar with the portfolio, can be a good resource in objectively evaluating the IP. Alternatively, previous knowledge can shorten the time spent on this step. The acquired knowledge should extend beyond the intended applications of the patents to the underlying technology as described in Chapter 2.1.3 Identification of Underlying Technology. The breakdown of Step 1: Understanding IP is outlined in Figure 8, which also includes the indication that to understand portfolio one must first take the time to read the IP.

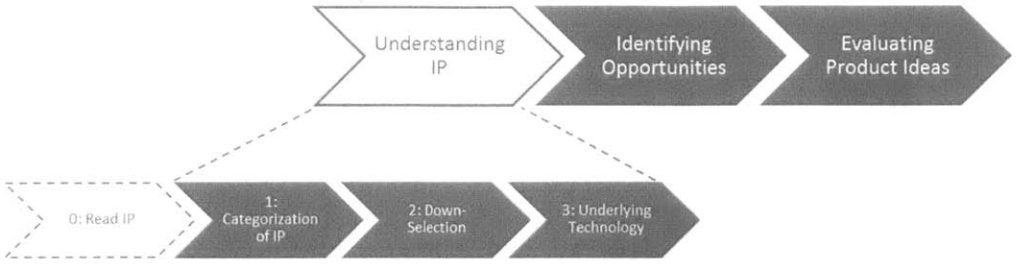

Figure 8: IP2PI Process Step 1 - Understanding IP

2.1.1 Categorization of Patents

After familiarizing oneself with the IP portfolio, the patents should be sorted based on content and remaining duration. Since the IP2PI process is looking for new product ideas to be developed in the future, any patents nearing their expiration can be eliminated. In the case of the Pelikan portfolio, we eliminated all patents with a priority date over 14 years ago, due to the assumption that they would expire before the new product could be developed and gain market penetration. The removal of foreign counterparts within patent families and those filed prior to a selected date represents the first step at sorting in Figure 9. Next we focused on the US patent filings. Countries operate independent patent and trademark offices, meaning that the patent application must be filed in each nation in which the company desires protection for the given invention. We focused on the US as the most complete set of patents and therefore the best representation of the included inventions. Pelikan was based in the USA and usually filed in country first before seeking protection elsewhere. Our focus on US patents also eliminated the language barrier. Once the list of US patents was finalized we moved on to the categorization.

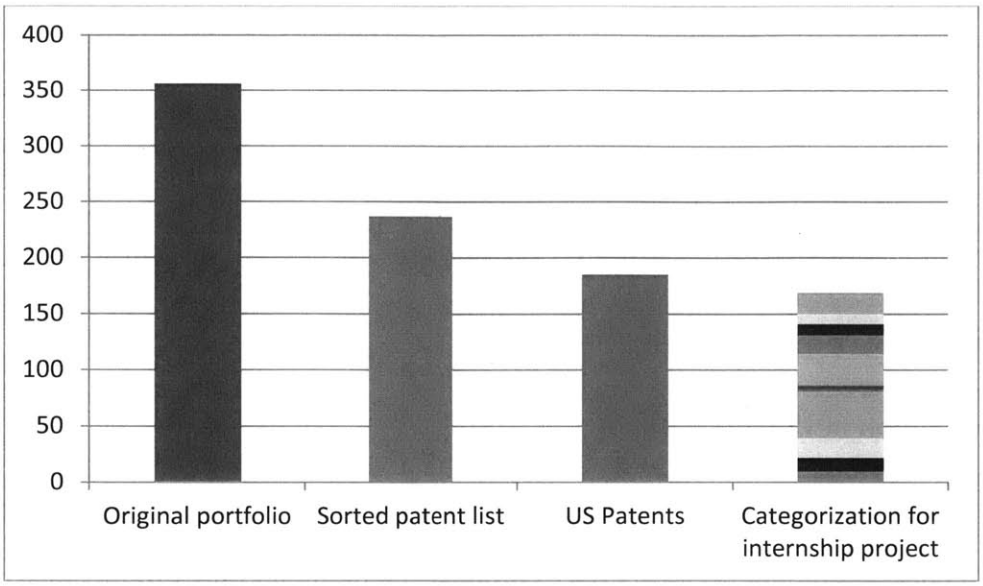

Figure 9: Stages of Pelikan Portfolio Categorization

The categorization of a portfolio will vary depending on the content area. In the case of Pelikan we identified eleven technology groupings into which we could divide the patents. Patents are most commonly categorized based on their intended application area. This is a useful method when maintaining the portfolio for the protection of existing products and applications. This can also be a good starting point and is usually the easiest to develop based on preexisting information. For IP2PI we ultimately want to distance ourselves from the intended application to identify new opportunities, moving beyond this initial categorization to start focusing on the patented technology rather than the intended application. Depending on the nature of the patents, extra effort should be taken to modify the categorization for technology areas as opposed to product applications.

At the end of the categorization exercise the working version of the Pelikan portfolio contained 169 patents in eleven categories. This stage of the process started off by reading the patents and obtaining a level of familiarity sufficient to categorize them. Ultimately the participants in the IP2PI process will need a detailed knowledge of the patents they are working

with, which requires focusing on a reasonable number of patents. The definition of reasonable in this case will depend on the individual and the amount of time they have to learn the details of the patents. In the case of the Pelikan portfolio and the limitations of the six-month internship, it was not possible to continue with 169 patents which led to the down-selection step described next.

2.1.2 Down-Selection

Down-selection can occur in multiple iterations. The goal is to end up with a manageable number of patents, with which the developer can become highly familiar before proceeding to the market research and product development stage.

The established patent categories can be evaluated based on a range of criteria. The exact selection used would depend on the purpose of the evaluation. It should be noted that evaluation criteria are often subjective and situation dependent. Some criteria are clearly subjective and depend on the viewpoint of the evaluator, others are considered objective and are based on analysis and direct comparisons. Examples of objective versus subjective criteria can be found in Table 3.

Table 3: Objective vs. Subjective Evaluation Criteria

Objective Criteria	Subjective Criteria
Number of patents contained in the portfolio category	Expected alignment of future applications with the company strategy and/or portfolio
Expiration date of the patents	Alignment with the background of the product development team or representative
Access to customers in target markets	Completeness of the technology, necessary development of supporting technologies
	Complexity of the technology
	Expected development costs
	Strength of the patent protection
	Ease of translation to new applications

It should be noted that this list is neither extensive nor applicable to all portfolio evaluations. While subjective criteria are clearly dependent on the viewpoint of the evaluator, objective criteria are also not without bias. The evaluator's opinions can be injected into the objective criteria through the assumptions and estimations used. Documenting the assumptions assures transparency in the process and can simplify later adjustments and modifications. Additionally the criterion can be assigned a value to adjust their influence on the down-selection results. This weight represents the importance of the corresponding criterion in this particular evaluation. The weighting is on a relative scale of importance and is often 1-5 or 1-10.

Next the patent categories are evaluated based on the given criteria. Down-selection matrixes are a simple way to visualize the process. The categories to be evaluated are represented in the columns, while the evaluation criteria are included as the rows. Figure 10 is an example of a down-selection matrix.

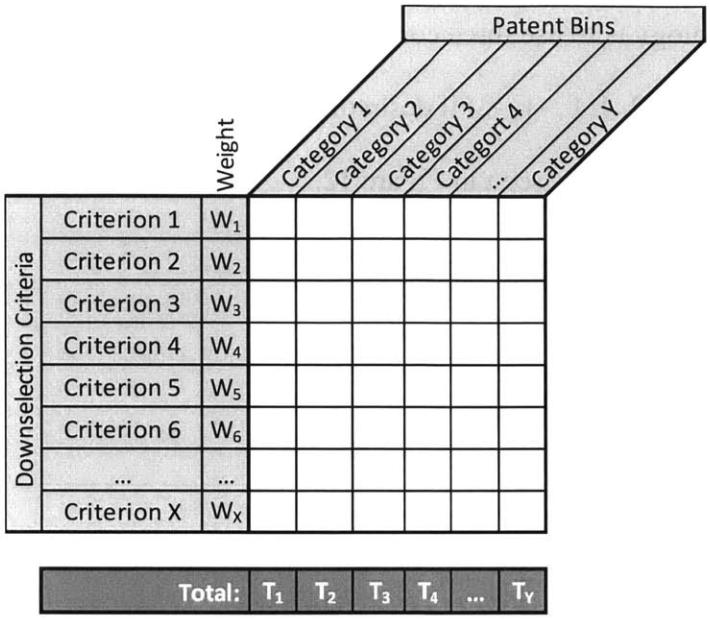

Figure 10: Down-selection Matrix, Step 1

There can be as many criteria and categories as desired. After adding the desired criteria, weights and categories, the evaluator fills out all the blank boxes with scores. A score is entered for each criterion X and category Y (Figure 11).

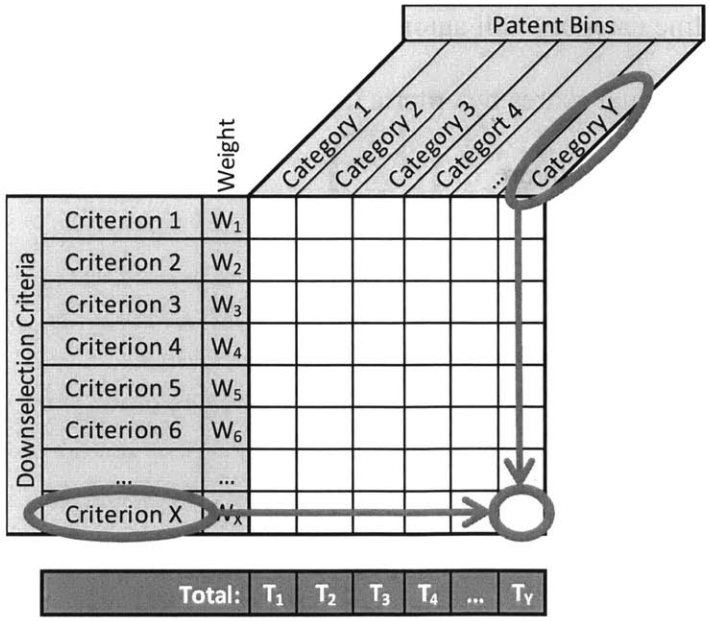

Figure 11: Down-selection Matrix, Step 2

A common scoring methodology is to use three comparative levels: 1, 0, and -1. The scoring can be expanded to five levels (2, 1, 0, -1, -2) if desired. Since scoring is comparative, it is advisable to designate a baseline category as seen in Figure 12.

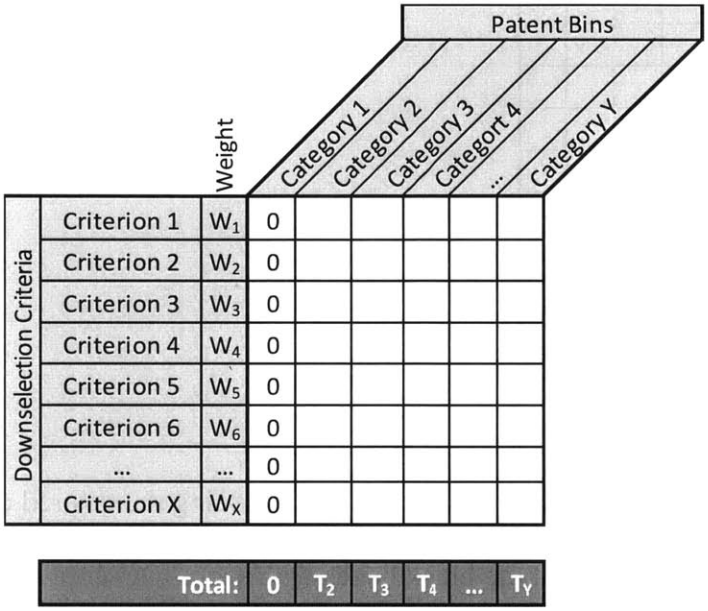

Figure 12: Baseline Category in Down-selection Matrix

The total score for this baseline category will automatically be zero. To calculate the score of each other category, the individual scores by criteria (S_{XY}) are multiplied by the corresponding weights (W_x) as illustrated in Figure 13.

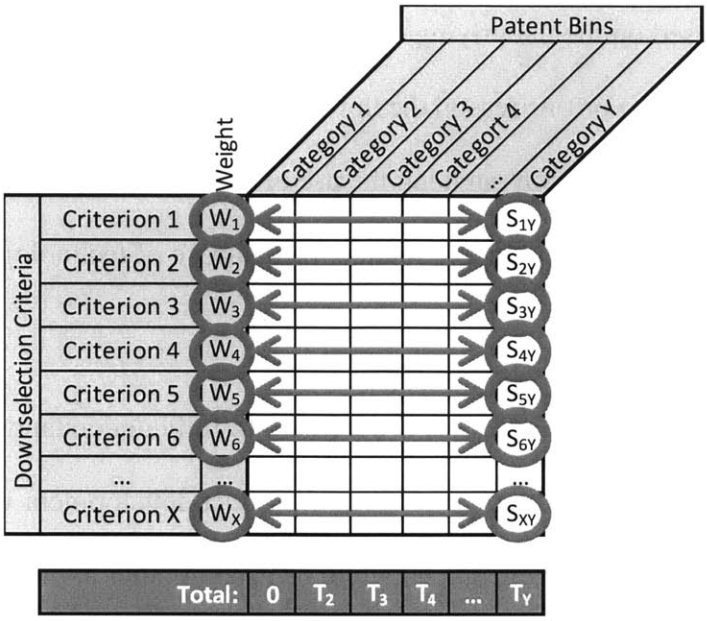

Figure 13: Down-selection Matrix, Scoring

The weighted scores are summed to calculate the total score for each category. This process can also be represented by Equation 1.

Equation 1: Calculation of the total score T for each category Y

$$T_Y = \sum_{i=1}^{X} W_i \times S_{iY}$$

Based on the comparative nature of the scores, primary categories should rise to the top of the scoring, indicating starting points for the IP2PI process. This method was used to identify the most promising categories with which to proceed. After the down-selection of the Pelikan portfolio, two categories with a total of approximately 70 patents were selected for the further development with the IP2PI process.

2.1.3 Identification of Underlying Technology

As mentioned in Chapter 2.1.1 Categorization of Patents, the ultimate goal is to categorize the patents based on underlying technologies, not the originally intended product

application. Categorizing patents based on the underlying technology requires an intimate knowledge of the content in each patent. For this reason the down-selection to 70 patents in two categories was conducted first. In an organization pursuing the use of patents for new product development on a larger scale, it could be worthwhile to maintain a database of technology based categorizations as described next.

In the pursuit of the "underlying technologies," it is necessary to fully understand the technologies on which the patent is based. For the purpose of new product development we are looking for descriptions of technology that are general enough to be used in other applications, while being specific enough to indicate a distinct innovation. The balancing act we are referring to is illustrated in the following examples.

Example 1

> *"**16.** The method of claim **1** further comprising using a feedback loop position sensor configured to measure the position and control the velocity of the tissue penetration element."*

Quote 3: Claim from Patent 7025774: Tissue Penetration Device (Freeman et al. 2006)

Claims are often a good starting point for understanding what invention the patent intended to protect. In this case, claim 16 (Quote 3) describes the use of a feedback loop position sensor. The feedback loop recited in claim 16 describes is configured to measure the position and control the velocity, but such a specifically described feedback loop position sensor may not be easily transferred to new product requiring position sensors generally and is therefore not ideal for the IP2PI process.

Example 2

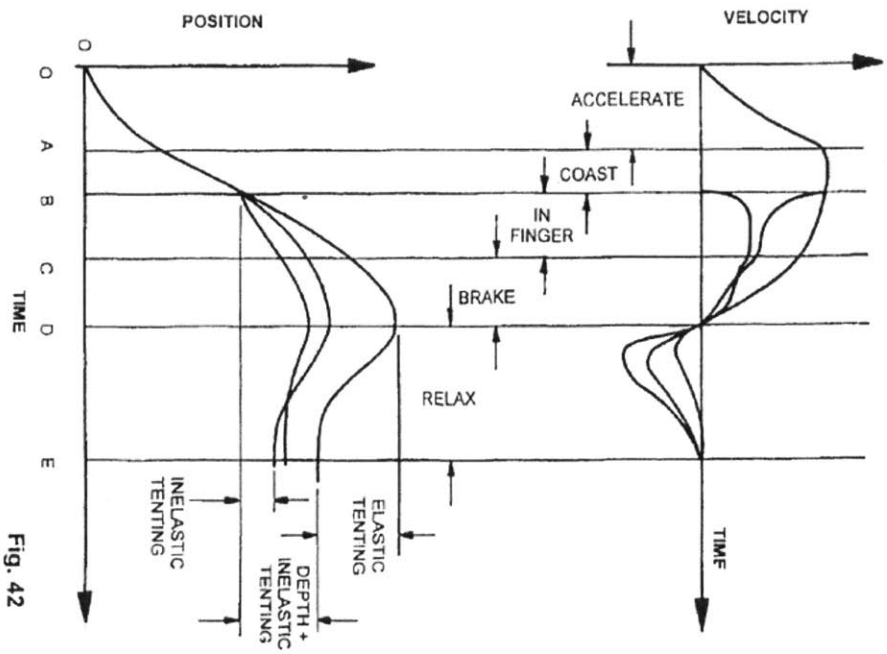

Figure 14: Graphical Representation of Position and Velocity vs. Time for a Lancing Cycle; Patent 7025774: Tissue Penetration Device (Freeman et al. 2006)

Another place to look for underlying technology references is in the figures. Figure 14 is the graphical representation of position and velocity vs. time profiles used in the tissue penetration device. In this case the question is whether the profiles have alternative applications. In the case of these profiles, for example, the interesting underlying technology comes the purpose of minimizing pain during lancing while ensuring the desired outcome of the tissue penetration process. This is an example of an underlying technology, which is included in the original patents and potentially applicable to new product ideas.

It is important to note that while the technology is protected in the context of the original application, new product ideas are not necessarily covered. Interestingly, while the IP2PI process is based off of existing IP, it can also lead to the generation of new IP in accordance with the new developments.

2.2 Identifying Applications and Market Opportunities

Upon identification of the underlying technologies in the down-selected patent portfolio, we proceed to Step 2 in the IP2PI process (Figure 15). This step focuses on the creative aspect of identifying opportunities that correlate with applications of the technologies included in the IP. The goal of this step is to identify new product opportunities.

Figure 15: IP2PI Process Step 2 – Identifying Opportunities

The creative process can take many forms corresponding to personal preference and the organization's culture. Brainstorming can be done by an individual or in groups. It can involve workshops, ideation sessions, focus groups and interviews with subject-matter experts. There is no prescribed way to tackle this step in the IP2PI process.

Formal brainstorming sessions could be considered an obvious starting point, when experts from various disciplines gather to generate as many ideas as possible, but even the value of this method is now being doubted by some in the field (Gobble 2014). Alternatively, long avoided in creative circles, electronic brainstorming is now being proven relatively effective assuming the proper tools and priming (Dennis, Minas, and Bhagwatwar 2013). We pursued multiple brainstorming methods in the application of IP2PI on the Pelikan portfolio. The methods included group brainstorming discussions, interviews of subject matter experts and conversations with a variety of users in adjacent fields to look for a wide array of application areas.

In any approach, the underlying technologies identified in the previous IP2PI step serve as a catalyst for the brainstorming, in that the technologies provide a multitude of starting points for opportunity identification. One clear starting point is researching new applications in the original application area of the patents. The next step could then be adjacent markets, where significant overlap can be expected. Subject-matter experts were of great use in the exploration of these areas related to Pelikan. On the other hand, conversations with randomly selected individuals provide what can be described as more "out-of-the-box" application areas. In every potential market, one consideration was the possibility of using the identified technologies to move a given activity downstream. This trend, which is especially prevalent in the medical field, refers to the transfer of activities to the person with the lowest training level possible to execute the activity safely with the ultimate goal being completion by a layperson or the patient.

Upon identification of potential application areas, the next item is the formulation of problem statements. Framing each opportunity as a problem to be solved refocuses the process and avoids collecting potential solutions. Eventually solutions would be developed for a given product opportunity, but at this point that limits the perception of the problem and the possible product ideas. Instead the focus is on the problem to be solved. If selected as the opportunity to be pursued, the product development process will help develop the proper solution, which most likely would not be the idea thought of at this point in the IP2PI process. Of course solution ideas can be recorded for future reference, but they are not the focus of this step.

In addition to the problem definition, each project should be assigned a meaningful title. Beyond that, the next step is to define product requirements. Rather than documenting a potential solution, the product idea should start with important features and specifications which would be vital to the success of the product.

2.3 Evaluating Market Needs and Product Ideas

The third and final step of the IP2PI process (Figure 16) provides a framework for evaluating the opportunities identified in Chapter 2.1.3 Identification of Underlying Technology. This includes identifying market needs for the problem statements, evaluating the potential benefits and risks, and managing the transition to the new product development process. The goal is to select promising product ideas for further development.

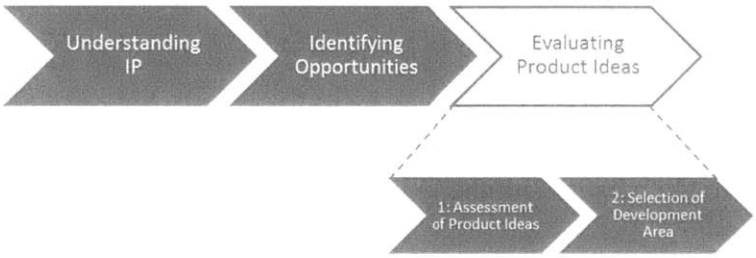

Figure 16: IP2PI Process Step 3 – Evaluating Product Ideas

2.3.1 Assessment of Product Ideas

The evaluation of potential product ideas begins with an assessment of the individual problem statements and associated product ideas. Ideally the assessment and evaluation would occur with no personal bias. The IP2PI process will always be conducted by humans, which is especially important during the brainstorming phase. The assessment phase on the other hand is better done objectively.

Before beginning the comparison, the evaluation criteria for each idea should be determined independently. The goal is to develop background information and important data about each idea, which will allow for an objective comparison at a later stage. At this point it is not important to know what the deciding factors will be to pursue a given idea, but rather which information will be needed to make such a decision. For example, at the assessment stage we are

looking to establish an estimate for market size, not judge whether this will be sufficient to move forward. Recommendations for the decision making process will be discussed in Chapter 2.3.2 Selection of the Development Area.

Further, we recommend establishing product idea form or other standard format in which this information will be collected. Standardization at this point facilitates the comparison, evaluation and decision making process during the next step. With the same information always recorded at the same place, it is easier for reviews to draw the necessary comparisons and conclusions. Additionally the key data sheets can be compiled and stored for future reference. Not every idea is worth pursuing in more depth at the current moment, but they can be valuable records to maintain. Depending on market changes, previous ideas could be worth pursuing in the future and a standardize database can facilitate this.

As mentioned the assessment of each product idea / problem statement should contain a basis of standard information. Some recommended items to cover are discussed in the following sections related to Market and Technology. The collected information should also cover any company specific requirements, which would be required before pursuing an idea further. Since the ultimate goal is to identify product ideas to pursue through the product development process, each product idea should include the information relevant to starting this process.

Market

For each problem statement it is important to identify the intended market. This includes defining target customers and application areas by geography, expected use, latent needs, among other factors. Many times a product idea could have multiple application areas, which should be developed independently. This helps pinpoint the intended customer and provide initial

specifications for the product. Identifying the market is also the first step towards understanding the competitive landscape and market needs.

When gauging the market potential it is important to look into the possible impact which the product can have. How many users can we expect to reach? How much will their situation be improved / how much impact can we have on their lives? Many such questions exist and can be used to stimulate the evaluation of this area. The goal is to understand the value the product will bring to the customer and thus the value to be created within the given market. This can be straightforward and include dollar value when assessing a product in an existing market. Whether or not the product aims to create a new market or greatly disrupt current markets, the exact value can be difficult to obtain and only rough estimates are expected.

When assessing the competitive environment, the first step is to identify existing products and competitors in the market. This includes directly comparable items as well as adjacent areas which may be included. If there are no current comparable items, it can also be noted how the new market will be created for the product idea.

The competitive landscape is often a good starting point for evaluating potential price positioning. Estimates can be based on the price commanded by current products in the market or fulfilling similar needs. It is also important to understand the payer situation, especially in the healthcare markets where user, payer and decision maker can be represented by separate groups such as patient, insurance and physicians respectively. The motivation of each group can factor into the acceptable market price as much, if not more, than the features included in the new product. The price positioning should be based on market dynamics, not the potential cost of producing the product.

Technology

The technology associated with a product idea will greatly affect the company's ability to develop and produce a profitable item. Ultimately the product costs in comparison to the expected price will determine the gross margin on the individual items. Such information will become more readily available as the development process progresses. At this early stage, the technological trends and the overall development are more significant. It is important to gauge the current state of technology required for the product idea and then what risks, time and costs are associated with the remaining development needs.

The technology risks and development costs represent the counterbalance to the potential upside estimated with the market potential and impact discussed earlier. Expected time and costs to bring the product to market are important factors, which are part of the business decision whether the company will be able to achieve a favorable return on investment. Additionally the risks associated with this technology development should be considered. For example, there is a very different level of risk associated with technologies that are available and just need to be combined versus those that require significant technology research and development either within the company or through an external organization. Gauging this risk is an important step in assessing each product idea.

Here we also recommend taking a look at the IP landscape for each product. While the IP2PI process is based on intellectual property, it is primarily designed to stimulate idea generation and extract some value out of existing material. Depending on the product idea, there may be great departure from the original patents, which can result in the opportunity to obtain additional intellectual property. Because of these potentially new developments, it is also important to search for existing intellectual property. In the case that there is existing intellectual

property relating the new product idea, it is worth identifying whether the existing IP can be designed around, acquired or whether it will present an obstacle to developing the product idea. Thus it is important to understand the context of potential filings, acquisitions and limitations.

2.3.2 Selection of the Development Area

Now that every product idea has been further developed and the key data identified, we can move into the selection process. During this step, the product ideas can and should be compared to each other. Direct comparison of key data sheets in the form of spreadsheets or a database is a straight forward option. Alternatively, visualization of the key information can help provide an overview, especially to those not familiar with the details and the process. One visualization attempt is shown in Figure 17.

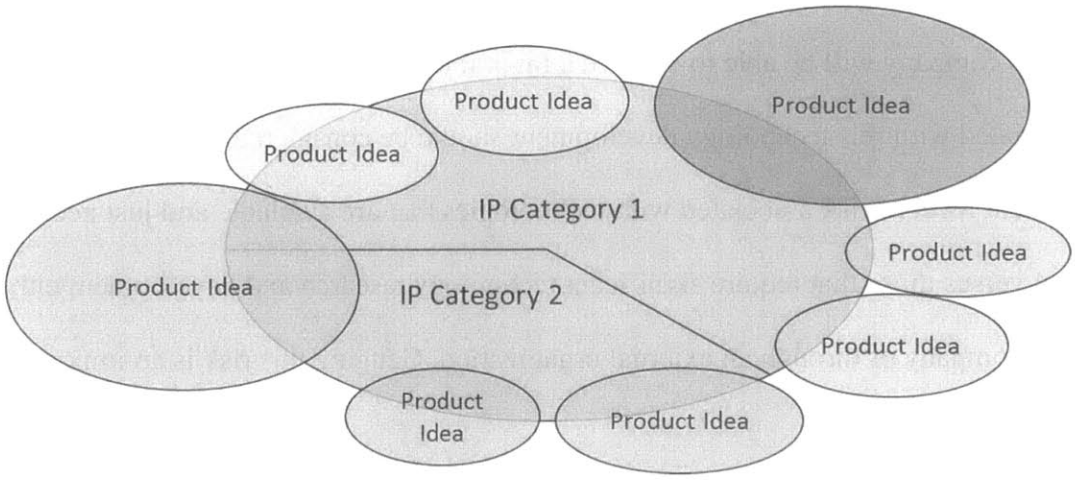

Figure 17: Visualization of Product Ideas

In this figure the product ideas are each represented by a bubble, the size of which indicates the potential impact of the idea. The color of the bubble represents the category of the application, for example orange could represent medical device ideas and green consumer products. The saturation of the color provides an additional data point, which here was selected to indicate the technology risks associated with developing the given product idea. Since this

visualization was developed in conjuncture with the IP2PI process, which is based on intellectual property, it was important to incorporate the connection to the initial portfolio. The blue base represents the selected patent categories. The overlap of product idea bubbles with the IP categories indicates the connection to, and the protection provided by, the initial portfolio. In all cases the size, saturation and overlap of individual bubbles are representations based on best estimates with current knowledge.

Such visualizations provide good starting points for the discussion about product ideas, yet there are many further considerations. For example, does the product qualify as a "good idea?" The exact qualifications necessary to obtain the "good idea" designation can vary by organization, but generally they should cover the market size, estimated revenue potential and competitive landscape. The goal is to answer the question whether the pursuit of this product idea is "worth it" (Ulrich and Eppinger 2012). At this top level, the question is in regard to the product idea only and should be answered without reference to company preferences. While ideas without sufficient market advantages do not warrant pursuit, we have multiple options for "good ideas." Figure 18: Pursuit Options illustrates the decision points and the potential outcomes for any given product idea.

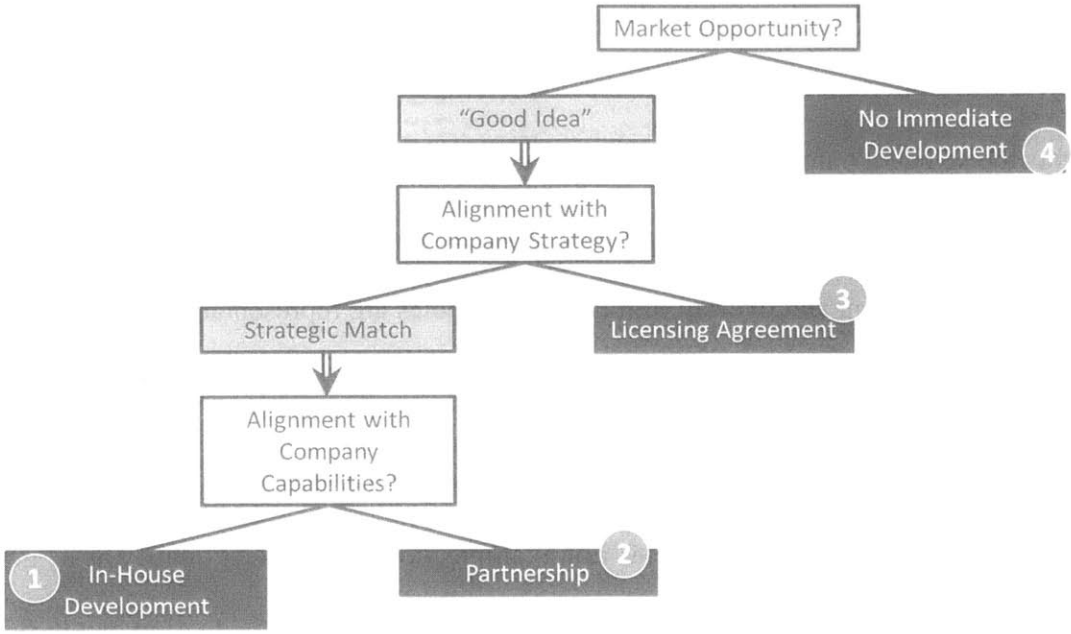

Figure 18: Pursuit Options

The discussion of the market opportunity should first establish whether an idea is worth pursuing. If the product idea is viable, then we can consider the alignment with the company strategy. Just as not every idea is worth pursuing, not every good idea is worth pursuing by every company. At this stage, it is important to evaluate how a given product idea fits with the company goal and mission. Misaligned products can be considered for development by external organizations. Properly packaged IP and product ideas can be bundled, then licensed or sold, representing potential income streams without development costs and risks. If the product idea matches the company internally, that does not automatically mean that is should be pursued immediately, if at all. Beyond a match with the company strategy, it is important to evaluate the potential timing and alignment with the company capabilities. This question covers both the resources and technology needed to develop the product as well as the potential impact (both positive and negative) on the company. While the timing of the development and product are a

consideration, it is also important to establish whether a given product should be pursued entirely within the company or through partnerships with other organizations.

There are four distinct outcomes of this decision tree:

1. In-house Development: The product idea is worth pursuing. The product will be developed within the company, since the product aligns with the company strategy, the development capabilities exist and the necessary resources are available.
2. Partnership: The product idea is worth pursuing. The product aligns with the company strategy, and therefore involvement in and ownership of the product are desired. Unfortunately the necessary development capabilities do not exist or the resources are not currently available, so that the product would be developed only as part of a partnership with an external organization. The external party supplies the needed capabilities and resources in exchange for the negotiated ownership stake or payment.
3. Licensing Agreement: The product idea is worth pursuing. The idea or intended market do not align with the direction of the company and therefore will not be pursued in any form internally. To generate income from the idea nonetheless, the idea and corresponding intellectual property are bundled for use by an external organization. The bundle can be licensed or sold, and the external party takes on all development risk and control.
4. No Immediate Development: After analysis of the product idea and market opportunity, the option is deemed not worth pursuing by anyone.

All opportunities in the first three categories should be considered for their revenue generating potential. Special consideration goes to products for in-house development which require the allocation of resources. All product ideas in this category must be compared and most likely ranked to determine the order of development based on capacity limitations. The precise nature of this comparison and ranking depends on the company's strategy, capabilities and internal decision making process.

During this decision making process we encourage the consideration of The Real Option Solution (Boer 2002) when evaluating the product development plan. Real options are the ability to take future actions related to the current choice, depending on the development of existing uncertainties (Ford and Sobek 2005). This includes the exploration of optional additions, versions and next steps associated with a given idea. The value of a given product idea starts with the value of that product, but can also be extended by considering the additional opportunities this development will enable. For example, if two product ideas share a necessary technology development associated with significant risk of completion, it is worth considering the product idea with lower required investment despite the smaller potential impact, if the new technology could then be carried over to the other product.

3 Conclusions

As mentioned in the introduction, the IP2PI process discussed in the previous section was developed as part of an LGO internship. Each step was developed and tested on the provided intellectual property portfolio and in the context of Sanofi's current business position. For that reason, the results of the IP2PI process could not be discussed in greater detail, while the focus will instead be on discussing the development of the process and its potential applications.

3.1 Review of the Deliverable

The goal of this research was to outline a process for extracting new product ideas from existing intellectual property. There is significant research available on product development processes, extending to idea generation, but nothing specifically on this problem statement. The existing research was consulted to guide the initial attempts at developing this process. After each attempted stage, it was important to reevaluate and adapt the process to better match the goal and requirements. In this simplest sense, the goal was met in that the IP2PI process provides guidelines for the generation of new product ideas from existing intellectual property portfolios.

IP2PI provides an alternative starting point for the product development process, while capturing previously unused value held in the intellectual property portfolios. The goal was not to utilize current IP, but to leverage it as the starting point for ideation and new product development. The process overview in Figure 19 shows that while the IP2PI process has only three steps, it fits into a much longer development process. Another aspect was to interface with a given company's product development process, and to that effect we have focused on flexible recommendations, which can be adapted accordingly.

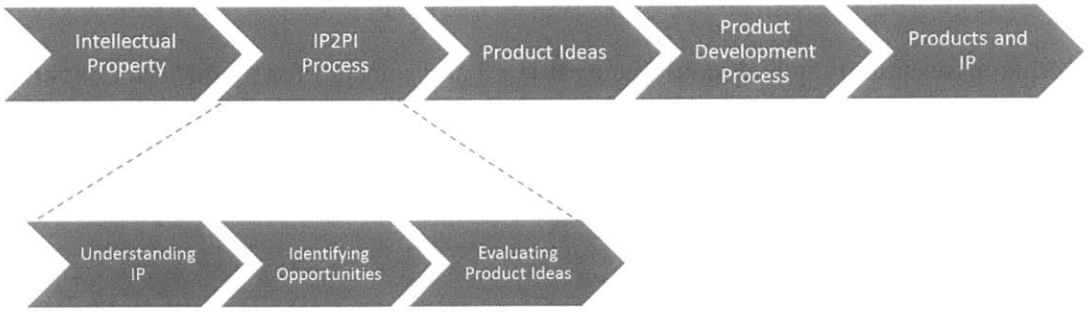

Figure 19: IP2PI Process Overview Recap

Interestingly the process begins with intellectual property, and in many cases where a product idea is fully developed, it will lead to additional intellectual property. Additional patent opportunities will incur fees and add to the monetary burden of a given portfolio. This is a standard situation for any new product development, but with the careful selection of ideas and management of the process the upside of the product opportunity will outweigh the additional IP costs.

This IP2PI process was developed on the given portfolio. The time limitation of the project did not allow for additional tests to be conducted on the process. With that in mind, the IP2PI process can be regarded as suggestions or as considerations when pursuing new product ideas from IP. Without additional applications on other portfolios or by other people, it is not possible to conclude that this is the overall optimal solution. It was the optimal solution for the given timeframe and parameters.

3.2 Next Steps

Going forward the results from this project can be developed along two possible paths. From the company's standpoint the results of this IP2PI process application can be used in the development of a new product idea. As intended the IP2PI process provided product ideas with their product assessments, which could be evaluated and selected for the product development processes. In this case the focus would be on results of the conducted IP2PI process and the follow-up steps as indicated by Figure 20.

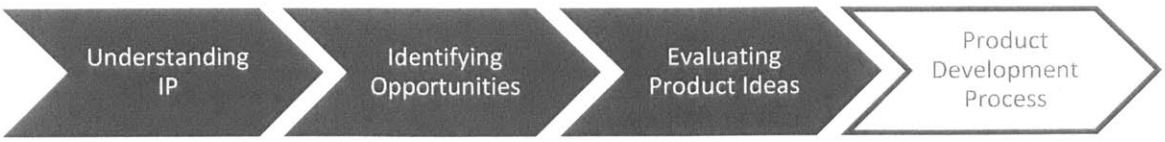

Figure 20: Next Step - Product Development Process

Alternatively the focus could be on the IP2PI process once again. As mentioned in the previous Chapter 3.1 Review of the Deliverable, the development of the IP2PI process was conducted in a single run-through. To improve the process or to confirm the results, the process should be conducted again with a change of parameters. This could include a new IP portfolio as input and/or the process being conducted by a different person.

Figure 21: Next Step - IP2PI Process

Additional attempts at the IP2PI process could provide independent data points, which would allow for additional refinement and evaluation of the process. In its current state the process is known only to function for a single person on a particular IP portfolio, although every attempt was taken to make it more generally applicable. To achieve the goal of a generally applicable process, the IP2PI process is framed as a set of recommendations. With additional development and testing the process could be ideally finalized for the benefit of organizations everywhere.

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