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Development of pricing techniques based on valuation methods of a patented dry-technology asset for value assessments

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Abstract

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This project thesis is to develop pricing techniques based on valuation methods for a patented dry-technology asset that is used in the recycling of batteries. The development of this dry-technology asset was derived from an EU Directive 2006/66/EC and institutional demands for more efficient and environmentally friendly technologies to recycle batteries. This demand is rapidly increasing all around the world.

The European Union-based case company has established a business and has built a recycling facility that has in-use the dry- technology. The recycling process produces renewable minerals (metal compounds) that are sold back to manufactures or metal producing companies.

The case company needs are to have in its business practice a reporting system of valuation methods and pricing techniques for the assessment of fair market, licensing, taxation and transaction values. The case company envisions on marketing and selling this unique dry-technology asset internationally.

The aim of this thesis study is to present valuation methods conductive to the case company needs and develop pricing techniques based on these methods for the dry-technology asset. The aim is also to give recommendations as to which valuation methods and pricing techniques should be taken into their business practice for value assessments and other issues that arise during the thesis research process.

The objectives are to demonstrate professional competencies, informative based on reliable supporting resources for the theoretical documentation on valuation methods and pricing techniques. To conduct qualitative analysis based on calculations and data.

The empirical research consists of a qualitative questionnaire, a visit to the recycling facility and conducting interviews with the case company's executives and its expert consultant. From the relevant literature gathered on the valuation methods and pricing techniques, conducting calculations by the use excel worksheets as working tools, this study provides to the case company the necessary means and methods for assessment of values of its dry-technology asset.

Keywords: technology / intangible asset, valuation methods, pricing techniques, and assessment values

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1 Introduction

Technology is the outcome of Research and Development (R&D) and the success is to create a new and useful technology, an intellectual asset, and it is sometimes bundled with other intellectual assets in a business operation. The patent of the technology can be combined with trade secrets, registered processes and product formulation systems. Technology as a business seed can bring to a company, opportunities, profit and growth. However, technology doesn't always warrant success in business. (Suzuki 2009.)

1.1 Thesis topic scope

The Bachelor's thesis topic is a product-oriented based. A company (the case company) has developed a unique dry-technology process for the recycling of batteries that is environmental friendly in all aspects. The unique dry-technology asset is one-of-a-kind and is has a patent.

The case company needs are to have in its business practice a structured reporting system of valuation methods and pricing techniques that provides assessments for fair market, licensing, taxation, and transaction values of the dry-technology asset. The case company's intention is to market and sale the dry-technology asset as a business model concept internationally.

The topic scope will inform on the different types of valuation methods and pricing techniques available that can be applied to the dry-technology asset. The valuation methods recommended to the case company will focus on the importance of assigning realistic values based on various factors of the dry-technology asset. (Potter 2007, 805.)

The valuation of this type of technology tends to be complex since the task of valuation involves determining the present value against the future value dry-technology asset will generate. Many methods have been developed based on economic theory and five (5) will be presented in this thesis study. However, in the end, the value that can be acceptable is usually a negotiated price between the parties. (Potter 2007, 805.)

For example, as Potter (2007, 806) points out, the value of a technology asset to a potential buyer depends upon how it is being commercially used, taking into account the cost of the research, design development, engineering, the time the technology takes to generate returns, the forecast of financial returns, and the risk involved in the process. At the time of a sales transaction, many, perhaps all, of these factors have been assessed and quantified. This assessment and forecast assessment are the essence of all pro forma business models.

1.2 Thesis objectives and goals

The thesis objectives are to demonstrate professional competencies, through researching on what has been accomplished in the market. Provide supporting theoretical documentation on valuation methods and pricing techniques. The pricing techniques will be based on the formulas presented from the valuation methods. To conduct calculations from the pricing techniques based on qualitative analysis. The qualitative analysis examines the quality of intangible asset, the useful life of the asset, and its importance relative to the business stream. The final results will be comparing realistic values and the qualitative analyses of the individual valuation methods.

However, to accomplish the objectives and meet the goal, researching questions asked have been formulated based on the patented dry-technology process in-line to the qualitative interviews that have been conducted. Information required from the case company in order for the pricing techniques to be done properly, will need relevant to be gathered and clarified. Some examples (Razgaitis 2007, 815.) of need documents but not limited to:

- A copy of the application file on the patent.
- Copies of any relevant business plan (model), marketing study, financial statements and independent appraisal, if available.
- Copies of any contract, licensing agreement or offer to license pertaining to the patent.
- Available economic data on the metal industry in which the invention is used.

- Cost information relating to the existing patent and the dry technology product including cost accounting records and/or engineering feasibility studies.
- Purchasing order requests (RFP) of raw materials (discarded batteries).
- Sales offers of the final renewable product to any third party.

Due to the confidentiality nature, a NDA was signed between the student and the case company. The case company will not allow for the above-mentioned documents to be included as attachments. Mainly, only the questionnaires and a matrix of questions & answers will be provided as attachments.

The goal of this thesis is to give recommendations to the case company of at least three (3) valuation methods and to show how to use the pricing techniques formulas associated with these valuations. Providing the working tools, excel formatted work-sheets, to be structured and taken into use inside the case company's business operation. Also, to inform of other findings that arise during the constructive research.

1.3 Background and the case company

As stated by the case company in its patent report:

> The rapid proliferation of portable electronic devices has resulted in a growing challenge as to how to cost effectively manage the disposal of batteries used to power these devices because the normal waste disposal infrastructure is not equipped to properly handle discarded batteries. Batteries contain materials and chemicals that, if allowed to leak into the environment, pose a significant threat to society. In addition, some batteries require metals that are costly to produce or are in limited supply. In many battery types these metals can be recovered from the discards and reused at a considerable economical advantage. Battery recycling process can provide both environmental and economic advantages. (Patentscope 2010.)

In the year 2006, the EU passed the Battery Directive 2006/66/EC of the European Parliament. In general terms the directive calls for Collection and Recycling Target:

- All portable batteries throughout EU Member States are subject to collection.
- The recycling of battery and accumulator content to produce similar products or for other purposes has to reach the following levels as of 26 September 2011.
  - At least 65% by average weight of lead-acid batteries and accumulators, including the recycling of the lead content to the highest degree that is technically feasible.

- 75% by average weight of nickel-cadmium batteries and accumulators, including the recycling of the lead content to the highest degree that is technically feasible.
- At least 50% by average weight of other battery and accumulator waste. (Europa 2006.)

The case company is a SME European-based, established in the year 2005 for the sole purpose of developing the eco-friendly dry-technology for battery recycling. The dry-technology was developed by a team of chemists and process technology experts for collection and recycling of batteries and accumulators from within the EU since 2006.

Currently, the company is a leading battery recycler that recycles hazardous portable batteries and accumulators in an environmentally sustainable manner. It has built a strong network and has one operating recycling facility located in the European Union. The case company's dry-technology battery recycling process can recycle the raw materials (discarded batteries) by volume of nearly 5 000 metric tons yearly. The case company employs on-the-average 12 employees working in the business.

1.4 Potential future market benefits

Battery consumption will increase, especially in developing BRIC countries. Over the next decade the fastest growing battery technology will be for electrical vehicles and the metals used in these batteries will be easy and profitable to recycle. Recycling legislation is under study in many of these countries and some have adopted similar regulations of the EU and some of the counties have approved even stricter legislation concerning battery recycling. In some developing countries they are creating recycling cultures for its citizens by training and making the collection system user friendly. (Batteryuniversity 2013.)

Closed loop battery recycling, where the recycled materials are potentially sold back to manufacturers and metal companies that likely will help against potential price fluctuation of metals or compounds. Electrical Vehicles (EV) battery recycling is expected to play a significant part of the value chain by 2016 when large quantities of EV batteries will come through the waste stream for recycling. (Wastemanagementworld 2014.)

1.5 International aspect

Currently, the case company has distribution partners and buyers for the renewable metals in Europe, USA and Asia for its existing operations. However, its target is to initiate cooperation firstly through the sale of the dry-technology asset to companies in Europe and USA, in a joint venture (J/V) format or direct sale to a third party company. It is planned to use similar approaches with potential buyers (companies) in Africa, Asia and BRIC countries. Each potential technology sale will be handled on case by case basis to insure against patent infringement.

2 Patented dry technology asset

The reasons for the case company to created and developed the dry-technology asset for the battery recycling market is that the current battery recycling technology is based on having batteries deep-frozen and then smelted at 2,000 degree centigrade. There are high costs associated with smelters and a large percentage of the valuable metals are lost in the smelter process. Also, the release of significant amounts of polluted wastewater, and in some cases smelters have exploded. (Case company 2013.)

Today, battery manufacturers seek and support an eco-friendly alternative that is a less costly solution. So the case company took the initiative in creating an eco-friendly process by the development of this dry-technology asset which is unique and is being protected by a patent in addition to patent protection certain elements of the process technology have been further developed but not yet available to the public. This dry-technology is the only technology on the market and to recycle batteries profitably. (Case company 2013.)

2.1 Most commonly used batteries

Lithium-ion and Li- polymer batteries (Li-Ion), Nickel-metal-hydride (Ni-MH) and alkaline batteries are the most commonly used batteries. However, the thesis focus is on the dry-technology process of Li-Ion and Ni-MH batteries.

The battery market is increasing mainly due to new battery technology to be used in automobiles, mobile telephones, computer and other devises. As an example, the battery industry produced over 660 million cylindrical Li-Ion cells, shown in figure 1. In 2012 and 2013 it will be close to 1 billion and forecast predicts the production to continue to increase significantly (Frantzanas 2012).

Figure 1. Lithium-ion batteries (Case company 2013).

The Ni-MH battery, as shown figure 2, represents about 22% of secondary batteries. It is a rechargeable power source that is mainly used in portable computers, cellular phones, and other digital devices. The most advanced rechargeable battery offered is the Ni-MH which provides up to 40 percent longer service life for high drain devices such as the new hybrid automobile vehicles (Searchmobilecomputing 2014).

Figure 2. Nickel-metal-hydride batteries (Case company 2013).

2.2 Dry technology asset description

The recycling process is a "proven Best Available Technique, (BAT)" (Case company 2013). It is a multi-step (phase) process comprising of receiving discarded batteries in bulk containers (raw material), sorting the received batteries into groups of like technology, separately chopping or crushing by using the patented dry-technology process

to produce final particulate matter and removing ferromagnetic material from the final particulate matter. The final renewable product, particulate metal matter, is then sold to manufacturers and metal refineries with a supplied outputting report. (Case company 2013.)

In figure 3, is a general view of the battery recycling process that is employing the dry-technology asset. A summary of the battery recycling process is presented herein.

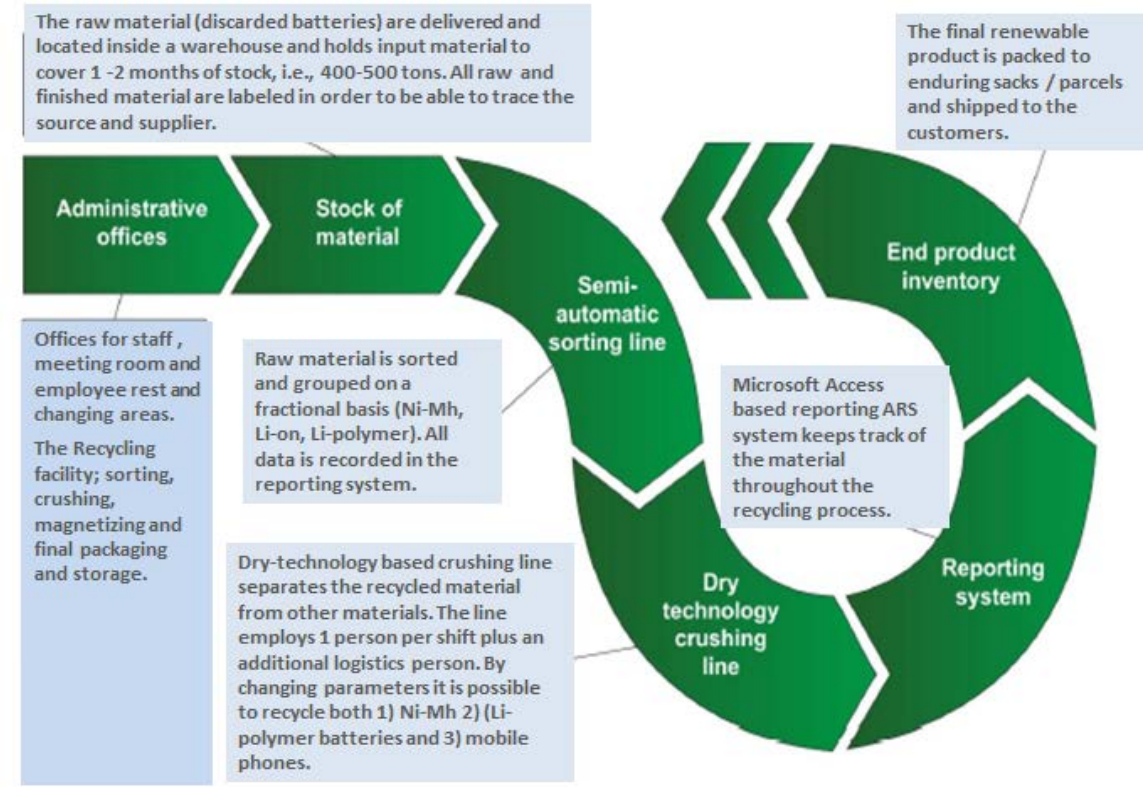


Figure 3. A general overall view of the battery recycling process (Case company 2013).

For this thesis study, the written summarization of the dry-technology asset and the process has been taken from the patent application.

> A practical battery recycling process takes in a bulk load of discarded batteries of all types. As each battery type contains different materials, chemicals, and packaging components separate recycling should be employed for each battery type. The output of the battery recycling process is the various recyclable materials gathered into groupings suitable for recovery of the constituent compounds and materials by refining or other separation processing. The battery recycling process, by itself, should minimize harmful environmental impact.

The method begins with receiving the discarded batteries in bulk, sorting the discarded batteries in accordance with battery technology type, separately crushing each of the battery types using an appropriate method, and collecting concentrated groupings of constituent materials and chemicals. Each of the concentrated groupings may be submitted for smelting or refining there by recovering the reusable materials.

For recycling Lithium-ion and Li- polymer batteries, the chopping further comprises: first chopping into pieces one inch or less wherein released gases are removed from the first chopping; and second chopping into pieces one quarter inch or less. For recycling Nickel-metal-hydride (Ni-MH) batteries, the chopping further comprises a single chopping or crushing into pieces one quarter inch or less. The removing Ferro -magnetic material is performed using a magnetic separator.

The remaining powder, from which the iron flakes have been removed, is refined to recover cobalt and copper that comprises over 95% of the powder. The remaining 5% are of recovered metals. The light plastic and cardboard waste material generated during the battery recycling process is thus sold to a smelter which burns this light material as energy.

In the dry- technology battery recycling process is a computerized reporting and tracking system (MS Access) employed to track record and report battery processing operations. This is support for clients by providing documents needed for waste transfer notifications. (Patentscope 2010.)

2.3 Environmental aspects

The unique patented dry- technology asset used in the battery recycling processs follows true green values in exceeding the EU mandate, see figure 4. This is accomplished by:

- The process is based on dry-technology that does not require any heating, is a closed loop technology having no wastewater or chemicals.
- Recycling rate is very high, >99 %.
- No emissions are released into the atmosphere during or after the recycling process.
- Safe processing of reactive materials.
- Operating costs are a fraction of the cost of smelter technology.

– Environmental management system is certified to ISO 14001 and ISO 9001.

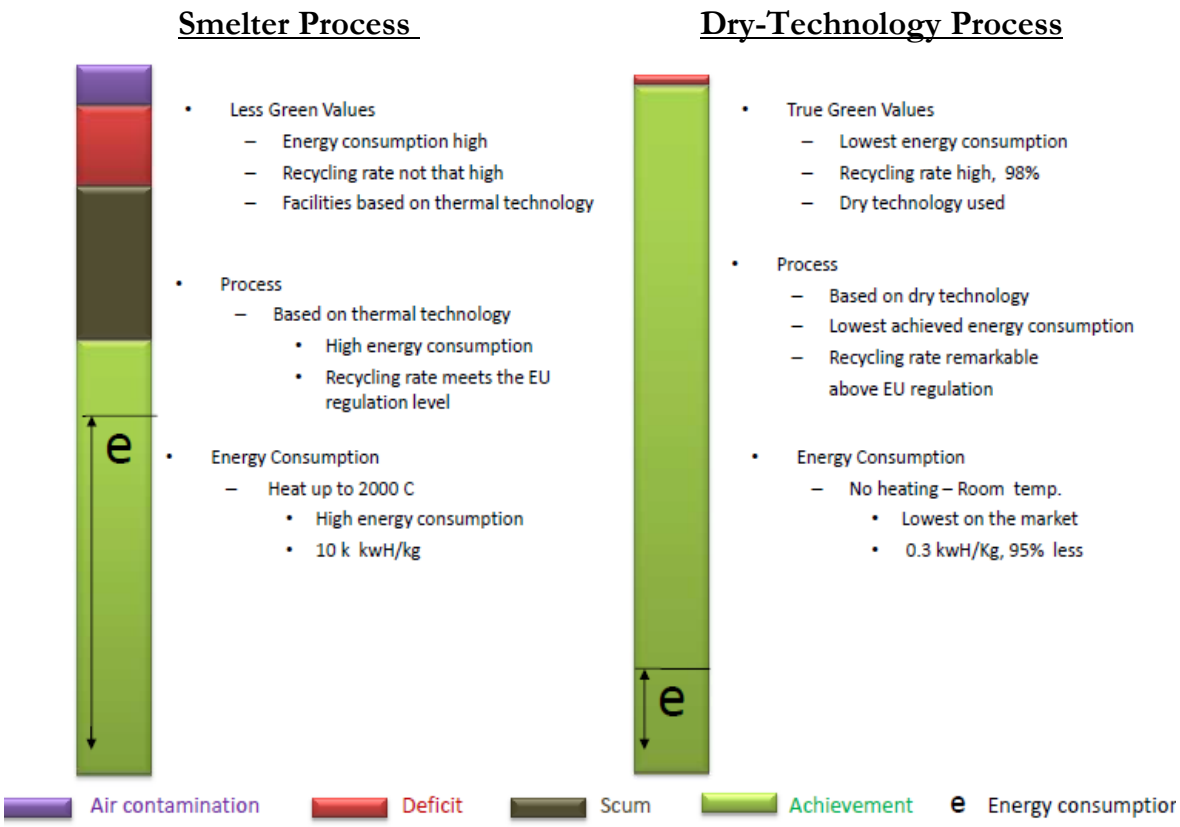


Figure 4. Technology of old smelter compared to today's dry-technology of true green values (Case company 2013).

2.4 Potential business model concept

The case company is developing a potential business model concept as seen in figure 5. The model starts from the product manufacturer to the initial sale of product (importers, retail, industry and logistics). Then through collection of batteries by recycling associations, who sells the raw material (discarded batteries) to the collector. Who in most cases is the company that has purchased or been granted a license to employ the dry technology asset, establish a business operation for the recycling of batteries which will produce renewable final products to be available for sale onto the market.

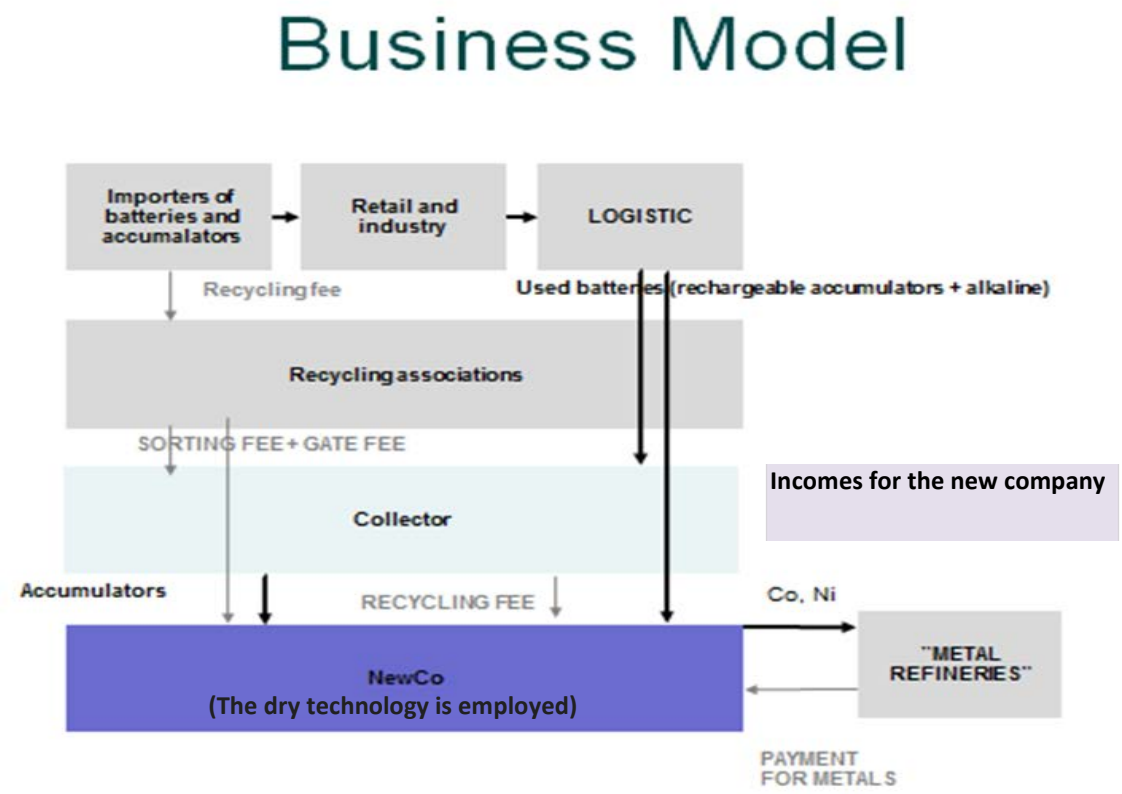


Figure 5. Potential business model concept (Case company 2013).

This model provides two main revenue sources:

- Gate/sorting fees for battery recycling, battery companies pay for collection and sorting of batteries.
- The sale of the final renewable product of valuable metals.

The use of spot hedging for the purchase of the raw material, the maximum purchase price is usually tied to the market price of the renewable metals obtained from the recycling process, thus eliminating risk from metal price fluctuations. Plus having in place working relationships with recycling associations, distribution partners and suppliers of the raw materials, and potential buyers for the renewwable metals from Europe, USA and Asia.

2.5 Risk management

Risk is a particularly important element in the valuation of the technology asset, for example WIPO (2011, 5), so if more time and money are needed to bring the technology onto the market this means less value.

- Time, how long does it take to bring the technology on the market; however, sometimes even breakthrough technology can be too early for the market.

- Money, how much more does the case company need to invest into market research, marketing plan, third party experts, legal fees, company's management cost towards selling and negotiations of the sales transaction.

- Spot hedging, volatility in the metals market and foreign currency exchanges.

- Patent Infringement protection, especially in developing countries like BRIC.

3 Theoretical

In the research of literature, there are many articles dedicated to the importance of these technological assets and to the problems of establishing and maintaining a price. The importance and the value of technological assets have increased consistently in the past two decades. Today the value of intangibles exceeds the value of tangibles by six-seven times compared to the beginning of the 80's where the value of tangible assets was twice that of intangibles. (Chiesa & Gilardoni, 2005, 7)

Today, technological assets play a key role in determining the value of the company and are becoming even more a powerful tool in facing competition in the market alongside the traditional assets (WIPO 2011,8).

3.1 Theoretical framework

The theoretical framework is based on review of relevant literature and documentation provided by the case company and various electronic sources, journals and text books. Reliable authors are sourced in the thesis having published high quality information and data.

The valuation methods are theoretically in context and presented with formulas. The valuation methods provide an insight for what needs to be accomplished to form conclusions. Both the positives and negatives aspects of the individual method are presented.

3.2 Key concepts

Intangible asset and technology asset has the same meaning in this study. Included herein from WIPO (2011, 7- 8) are clarifications for valuation and value:

- Valuation is the process of identifying and measuring the financial benefit of an asset.
- Valuation of intangibles is a process of identifying and measuring financial benefit and risk of the asset, in a particular perspective.

- The potential value of an intangible is the financial benefit that the asset can generate in a particular setting which will be realized.
- Most intangibles have the capability to generate more than one revenue stream simultaneously.
- In certain situations the value is determined by the authority, relevant laws (tax) or empirical experiences.
- It is important to define method(s) to value intangibles, for understanding the actual value of an asset in use for negotiation purposes.

3.3 Valuation methods

For the theory purpose and not going in-depth on "why patents", presented is a simple analogy; "at the most general level, a firm will choose to purchase or license either to earn revenues, or because the purchase or licensing serves a strategic purpose." (Farrell & Gallini 1988 in Lerner & Layne-Farrar 2006, 2.)

Transferring know-how is problematic as potential buyers are reluctant to pay upfront for unproven specified knowledge, not knowing the value and fearing the seller of technology will not provide all relevant information. The seller for their part, are reluctant to provide any trade secrets without upfront payment, fearing the buyer will use the information without paying. Complementary input in the form of patents can enable contracts that solve both parties' concerns. The seller can withdraw the patent rights if the buyer fails to meet contract terms. The buyer can refuse to make further payments if the seller fails to provide the necessary know-how to fully use the patented innovation. (Lerner & Layne-Farrar 2006, 7-8.)

Technology based assets can generate income and brings value that can be bought, sold and or licensed out. This spectacle is becoming increasingly important and it is highlighted by the fact that manufactures (batteries for example) are increasingly relying on external sources of process technology to support their innovations. (Pitkethly 1997, 5.)

3.3.1 Cost based methods

In this valuation method, Chiesa & Gilardoni (2005, 9) informs there are three methods commonly used:

- Trending historic costs, being current historical asset development costs which are identified and qualified and then "trended" to the valuation data by an appropriate inflation-based index factor.

- Reproduction cost is the total cost at current price to develop and exact duplicate of the subject technology. This duplicate asset would be created using the same materials and equipment standards, design and layout, and quality used to create the original technology as closely as possible.

- Replacement cost is the total cost to reestablish at current prices, having equal to the output of the subject technology to be appraised. This replacement technology would be created using modern computerized techniques to enhance to any upgraded standards, state of the art design and layout and to the highest possible quality. In the end, the final result would likely be that the replacement technology would have a greater output the original. This method is the most common one taken into practice.

These cost methods are simple approaches to pricing the technology asset. In many ways it simply calculates the cost of developing and patenting a technology and then adds an arbitrary profit margin to that cost in order to estimate the price (Lerner & Layne-Farrar 2006, 8).

In formula form: Price = updated Cost + Margin

However, there is no method to incorporate revenue or profit data; it therefore ignores these important data by which the value of assets is typically measured (Anson(2010, 3). Also, informs costs that should be calculated in the analysis:

- Legal fees
- Application/registration of patent fees and other
- Personnel costs
- Research and development costs
- Engineering and process costs
- Marketing and advertising costs

Overall the cost method is somewhat financially naïve. The cost of creation will bear little relation to the economic benefits, trends of demand, and value of use in today's market. Its most serious failing is that they make no real allowances for the future benefits which might accrue from the patented technology (Pitkethly 1997, 6).

3.3.2 Market based method

This method is largely natural and easily understood, for this reason it is widely adopted. The function of the market method by Chiesa & Gilardoni (2005, 10.) can be summarized as follows:

- Identifying the units of comparison (comparable), meaning that it is comparing apples to apples. Features commonly looked at to select the appropriate comparable are: industry, market share, capital investments required for R & D and creation of the technology.

- For each comparable, the appraiser has to collect data about the transaction, the value at which the transaction has been concluded and economic measures, such as revenue, or margin, or net profit associated to the technology-based asset.

- Calculating the ratio between the value of the transaction and the economic measures. This ratio is called "multiple". Applying the "multiple" to determine the value of the technology.

In formula form:

PV (Patent) = (Market Capitalization) – (Value of Tangible Assets) – (Value of Non-Patent Intangible Assets)

Requirements for successful use of this method must include, the market has to be active (real) and the market has to be public, meaning the information of exchanges have to be available. The offset, its inherent weakness of this method as to the difficulty of obtaining data for the technology asset of which are not considered by the market based method as it assumes that the value of the transaction is similar to that of comparable technology. (Chiesa & Gilardoni 2005, 10.)

3.3.3 Income method using discounted cash flows DCF

Is the projection of future revenues that the technology asset can be expected to generate on the market over a certain period of time taking into account the time, value of the money and the risk that the income will not be realized (WIPO 2011, 18).

The value of a patent technology asset can be expressed as the present value by a pure income method which is a calculation of the future cash flows (discounted cash flows) several years into the future, the time horizon considered in which the future cash flows can be generated and reliably estimated, and the actualization rate which reflects the business risk and this usually estimated (Chiesa & Gilardoni, 2005, 11).

Additionally, this method relies heavily on allocation of risk, determining what the chances are of a disappointing return or even of no return at all and who should take such risk, say the buyer? Risk estimates are crucial for the buyer in determining whether to invest into a new technology, however, risks are too often based on little more than that it can be controlled. (Iphandbook 2007, 795.)

The formula needed for the value of the asset is shown below (Chiesa & Gilardoni, 2005, 11).

$$V_T = \sum_{t=1}^{T} \frac{NCF(t)}{(1+k_b)t}$$

Where:

V*T* = technological asset value.

NCF(t) = net cash flow.

kb = actualization rate reflecting business risk.

T = time horizon.

The future income streams (net cash flows) are then discounted using present value calculations to determine the asset's current value. An asset is worth the present value of its future economic outlays that will accrue to its owner (Anson 2010, 5).

It is stated through most literature that this method is the most accurate in valuing a technology asset as it considers the specific operating environment (market size, pricing, cost structure, and risk) in which the technology is utilized. The big drawback in general to this method is that lack of consideration for the time value of cash and the risk associated which to predict future revenues (Razgaitis 2007,839).

3.3.4 Relief from royalty method

With this method, the value of the intangible asset is calculated as the present value of the royalties that the company is relieved from paying or to receive payment as a result of ownership of the asset. As stated by Anson (2010, 6) "it measures value by estimating future revenue associated with the asset over its remaining economic life and then applying an appropriate (industry standard) royalty rate to the revenue estimate."

The royalty rate isolates the portion of value that is attributable to the intangible asset from the value of the overall business operation. The use of marketplace or industry standard royalty rates in this analysis carries additional credibility to the realistic value. The present value of the estimated royalty payment is then calculated using a discount

rate that incorporates all the associated risks involved in achieving the revenue forecasts and royalty streams (Anson 2010, 6).

In formula form:

$$\sum_{n=1}^{T} \frac{(expected\ annual\ revenue\ \ x\ number\ of\ periods)\ x\ (assumed\ royalty\ rate)}{(1 + discount\ rate\ \ \ )}$$

Where:

T = Period subject to evaluation: Years 1 to T
R = royalty rate (industry standard or other means)
N = Discount rate, the expected rate of return for the technology asset.

To continue with Anson (2010, 6) "the range of applicable royalty rates discovered during the analysis will most likely be fairly wide. This all depends on the various agreements which will largely be due to the relative strength of the asset being licensed, product usage, competitive advantage, and its market share characteristics."

The key to an accurate valuation is to use the proper the correct royalty rate in the calculation. In some industries, standard royalty rates information is available so it could be already applied if the technology asset is being valued for a sales transaction. One needs to conduct some form of a comparative strength analysis which help to narrow the range of royalty rates to one that is more appropriate, e.g. as a seller considers as a fair deal to receive 5% - 10% of the buyers revenue and not its profit. However, for internal valuation, the use of royalty rates method not recommended. (WIPO 2011, 34.)

3.3.5 Technology factor method TFM

This is a proposed newer method, applicable only to technology which is gaining acceptance e.g. dry-technology for the recycling of batteries. "The TFM is designed to measure the portion of a business's overall market value that is based on the utilization of the primary technology asset. In a potential sales transaction between a buyer and

seller, the aspect of a fair market value definition is an input into this method by scoring a series of attributes as to whether they favor a buyer or a seller in a hypothetical negotiation." (Anson 2010, 7.)

The first step is to forecast the business's operating result that is using the technology asset. The present value of this cash flow is then calculated by using a discount factor that includes all risks associated with the formation of estimated future results. Accurate use of this technique depends on establishing the appropriate technology factor scale. (Anson 2010, 7.)

This factor is determined by establishing an upper limit for the contribution of value provided by the technology asset used in a particular process and then performing a relative strength analysis on the various value and competitive attributes. This will narrow the contribution of the technology to a specific percentage within that upper limit (Anson 2010, 8).

The established upper limit represents the maximum percentage of the total business value that can be attributed to the technology asset in a particular process. As in the case of recycling of batteries, where the final renewable products feature large contributions from the dry-technology which will have relatively high upper limits. Compared to those products requiring little contribution from the technology, minimal extraction, will have relatively low upper limits. (Anson 2010, 8.)

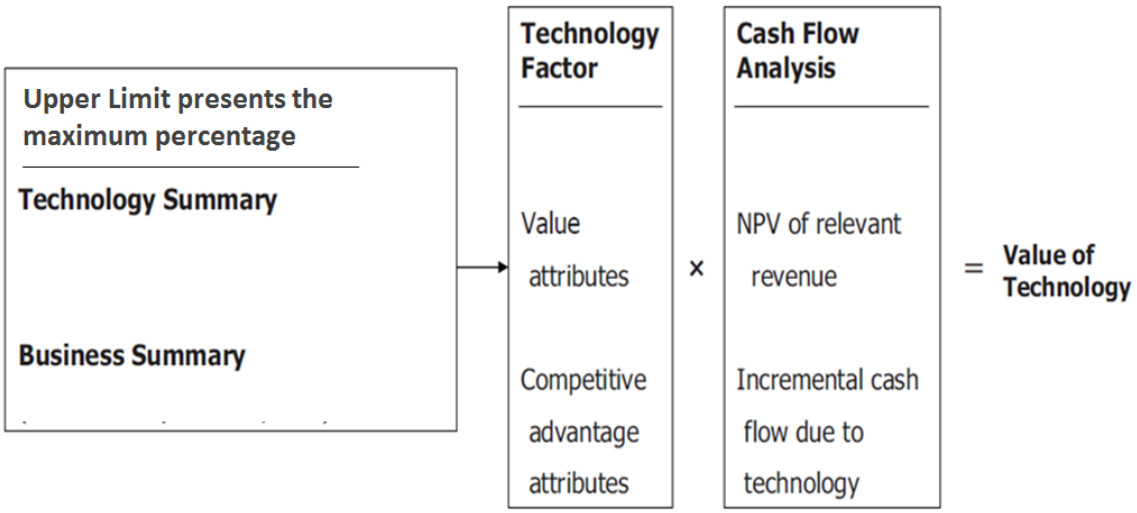
As for the various competitive and value attributes that reflect the strengths and weaknesses of the technology are reviewed. As mentioned, Anson (2010, 8.) for the value attributes examples typically included in the analysis:

- The current stage of the technology.
- The level of needed capital to commercialize the technology asset.
- The size of the potential markets.
- The profit margins associated with the business operation.

Examples typically included of competitive attributes are:

- The existence of alternative technologies.
- The potential for obsolescence of the technology.
- How the competition will likely response.
- The technology's potential patent infringements.

Table 1. In formula form Suzuki (2009).



The value and competitive attribute averages are weighted, according to their relative contribution to the overall determination of technology value. The median of these two averages (value + competitive) is then taken to arrive at the final technology factors. The result is then multiplied by the net present the value of the technology. This then arrives at the value of the technology asset of which can be set apart from the value contributed by other assets of the business. (Anson 2010, 8.)

3.4 The appraisal process

According to the valuation methods presented above, a framework is formed, aiming to give a view of the appraisal process and to identify the most critical challenges. Within the framework, (Chiesa & Gilardoni 2005, 12) three different elements need to be known:

- Activities represent the logical of the appraisal process by identifying the unit, aim and scope of analysis. To identify the most appropriate valuation method(s), col-

lecting data and comparing available and necessary data and finally determining the price (value) of the asset.

- The process is affected by constraints mainly the availability of data and necessary data and allocation of resources/time required to apply method(s).
- The links represent the relationship between two or more logical phases. However, the links do not indicate a sequential relationship, but a logical one. Different phases can be conducted temporarily, and there could be other types of feedbacks to be incorporated in appraisal process.

The four of five valuation methods discussed above represent the most widely used methods in the marketplace and the newer one, TFM, is gaining popularity in valuing unique technology assets. Understanding the distinctions of each individual method will help determine which method(s) may be appropriate for the intangible asset or assets in question. (Anson 2010, 7)

4 Empirical

Based on the theory for valuation methods, pricing techniques are developed for use in financial development. Pricing techniques are receiving growing attention in R&D and in new technology development due to reason that it can provide real support the decision-making process. As in this study not all the decisions of the case company are made in the present but are deferred to be examined the future.

As mentioned earlier in this thesis study, the importance of establishing the value based on a pricing technique of a technological asset is critical during a sales transaction process.

4.1 Target of the research

The constructive research approach (Lukka 2006) was used in this thesis study. In figure 6, it shows the approach being taken into use:

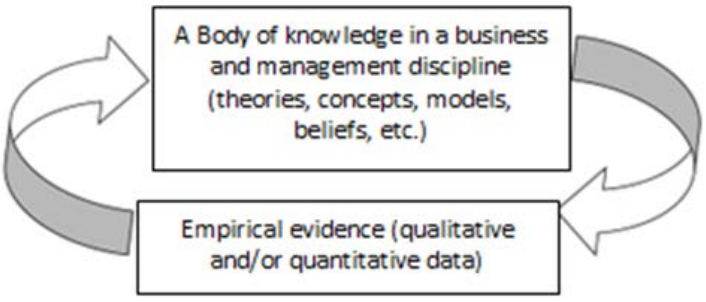


Figure 6. Elements of Constructive Research (Lukka 2006)

The target of the empirical section was to conduct interviews with 3 executives from the case company; Chairman, President and Operations manager and its expert consultant (independent). This is done to obtain a better understanding as to this dry-technology asset, the recycling process and the final products it produces that are then sold onto the open market. Also, to listen and acknowledge as to how these persons view the valuation method(s) in used today and in the future.

These interviews will add support to the importance of this dry-technology and in determining valuation method(s) and pricing techniques to be taken into use inside the

case company's business of operation and for future marketing of the business model concept.

The calculations in the pricing techniques for the technology asset are based on qualitative analysis. Qualitative methods provide a value guide through the rating and scoring of the technology asset based on factors which can influence its value. It examines the quality of intangible asset, the useful life of the asset, its importance relative to the business stream, the economy market and industry within which the business operates and the potential value for the business's current and potential competitors. (WIPO 2011, 9.)

4.2 Data collection

Two separate questionnaires were developed one for the case company's executives and the other for the expert consultant (see attachments 1 and 2). These questionnaires were email beforehand to the individuals so they may conduct their own research for providing answers.

The face-to-face interviews were conducted along with an observation visit to the case company's existing recycling facility on 4 February 2014. The interviews conducted were with Chairman, President and Director of Operations from the case company. The interview types were a combination of a structured one-on-one and an open interview with the three executives together. Similarly, a structured face-to-face interview with the expert consultant took place on 13 February 2014.

From the interviews, two of the executives had prepared their answers together and their answers were presented. The third executive provided his own answers to the questionnaire as with the same for the expert consultant.

Observation; walk through of the premises, warehousing and recycling facility and was informed that all of the facilities meet the EU requirements for storage of the raw materials and of the renewable metals and the recycling process, by the executives of the case company.

The company has received certifications of ISO 9001 and ISO 14001for Quality Management and Environmental Management and follows the guidelines, practices, procedures and processes of and from the ISO (International Organization for Standardization), (2014).

The case company provided needed documentation, financial statements, purchase order and sales offers for review and useful for carrying out this thesis study (DNA).

4.3 Objectives, research questions and development

From the questionnaires and interviews conducted, a matrix table, table 2, see attachment 3, was created and it correlates the questions with their answers from the three executives and the expert consultant.

However, from the questionnaire, two important questions and the answers provided by the interviewees in table 3 will assist in developing the basis for which valuation methods and pricing techniques are determined and calculated.

Table 3. Questions and answers from the questionnaires and interviews.

Questions Presented:	**Answers: Consensus from the interviewees**
4) What is your opinion on what method(s) has the company considered as to the valuation to be used for pricing techniques of the patent and dry-technology process?	
Cost Method	Executives stated as most important, however, Expert disagreed stating it brings no real value to the technology.
Market Method	Executives' answers were mainly about a fail attempt by a French company to develop a similar technology. Expert stated new technology so no market for comparison.
Income Method	Executives, cash flow discount needs to be valued. Expert, in use with inputs from the existing operations.
Relief form Royalty Method	Executives and Expert all agreed if handle as a licensing transaction, however, concerns about patent infringements in the BRIC countries.
The Technology Factor Method	Executives would like to have more information on this method with formula(s). Expert would like to have in use in the future.
Environmental Value Method	Executives were interested to know more, however, Expert stated "no interest from the potential buyers in the market". Main reasons are; too complicated and complex to conduct a valuation and set a realistic price. It was recommended by the expert to keep out this method from the thesis study because of the complexity of valuation and lack of real data.
Others that could be presented in the thesis	Expert; a hybrid method, combining market and income methods, in the future.
5) Has any valuation been done on the patent as to its value? If so, is any documentation available for review?	Executives; Yes, the Cost and Income methods, documentation is limited and will be made available for review. Expert's concern was that no comparison between real on-going calculations and what is presented in the thesis study for the Income method.

In bringing together, the theoretical material and the consensus answers from the questionnaire and interviews, the valuation methods and pricing techniques best suited by the case company for the qualitative analyses are:

- Cost based method, trending
- Income method DCF
- Relief from royalty method

- Technology factor method TFM

The pricing techniques are presented herein along with descriptions on how the calculations were conducted. These methods and pricing techniques represent more realistic values of the case company's dry-technology asset under today's economic conditions. Also, there may be a comfort level among the executives to use and trust these methods in actual practice inside the case company's business of operations and for the business model concept.

4.4 Qualifying valuation methods and pricing techniques

The qualitative study is used to formulate and justify assumptions on how the price technique determine a realistic value to the technology asset under review and will be based (WIPO 2011, 9). There is an element of concern due to the amount of data and figures needed to take into use of these valuation methods. Within these valuation methods and formulas, a practical approach is used in the pricing techniques. The figures presented in the calculations are from the case company; however, a multiplier is used for distortion.

4.4.1 Cost based method

From question 4, in the questionnaire: the cost based method for the executives was what they understood as being currently used, however, the expert consultant totally disagreed. Overall this method can often be looked upon as providing a basis or minimum value for the technology asset. In table 4 it illustrates how trending replacement costs can often be different from historical costs. (Anson 2010, 3.)

For calculations purposes, the trending placement costs are compared from year 2007 when the dry-technology was put into use, to year 2013, currently producing. The indexing being used is from the Finnish Consumer Price Index (CPI). CPI's principle gauges the prices of goods and services indicating whether the economy is experiencing inflation, deflation or stagflation (Investopedia 2014).

Table 4. Consumer Price Index (Statistics Finland 2014).

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013
Annual average	100.0	101.6	104.1	108.3	108.3	109.7	113.5	116.7	118.4

Year 2005=100

To determine the indexing it is year 2013 minus year 2007.

118.4 – 104.1 = 14.3

1 + .143 = 1.143

So the calculations performed are done by taking the Historic Cost and multiplying by the CPI rate to arrive at the Current Cost, as shown in the table, Table 5.

Table 5. Trending replacement cost method in EUR (Anson 2010, 3).

	Historic Cost	**CPI Rate:**	**Current Cost**
Data development	100 000		114 300
Labor / Research costs	300 000	X 1.143	342 900
Legal fees	50 000		57 150
Technology development	300 000		342 900
Other	50 000		57 150
Total replacement cost of the technology asset	800 000		914 400

In this method the level of uncertainty is much higher and the knowledge of the future business is very limited. In conclusion, the trending replacement cost based method appears inappropriate in establishing a value of the technology, as it is applicable only when the extent of uncertainty is very high and even then only a benchmark figure. (Chiesa & Gilardoni 2005, 10).

4.4.2 Income method DCF

The Income method estimates the future income streams expected from the use of the technology asset being valued. The future income streams are then discounted via pre-

sent value calculations to determine their current value. This is one of the most widely used methods, due to the information necessary to determine value is usually relatively accurate, and often readily available. (Anson 2010, 4; Chiesa & Gilardoni 2005, 11.)

The parameters used in the worksheet shown in table 6 include:

- Future income stream; from the entire business operations; cash flows projections.
- Number of years of the income stream; 10 years, based on an estimated remaining life of the dry-technology.
- Risk associated with the generation of the income stream; 20.995%.

Table 6. Income method – discounted cash flow

Discounted Cash Flow Worksheet										
	Growth rate on average:		5.0%							
Years:	1	2	3	4	5	6	7	8	9	10
€										
Cash Flow	200,000.0	210,000.0	220,500.0	231,525.0	243,101.3	255,256.3	268,019.1	281,420.1	295,491.1	310,265.6
Discount Factor	1.2099500	1.463979	1.7713414	2.1432345	2.593206607	3.1376503	3.7964	4.5934542	5.5578499	6.7247205
* Discount rate	20.995%									
Discounted Cash Flow	165296.09	143444.68	124481.93	108025.98	93745.42	81352.696	70598.23	61265.46	53166.44	46138.07
NPV										
947515.00										
€ 947,515.00	Value of the Technology									
* Assumption: 30% of cashflow comes from other fees and revenue.					16.15% x (1+.30)= 20.995%					

Source: Own worksheet

From the worksheet are the necessary calculations:

1. Net cash flow, year 1 is based on the case company's financial statements for the previous year 2012, year 2 to 10 projecting a growth rate at an average of 5%.

2. Discount rate is formulated by using factors with corresponding percentages developed in the discount rate analysis, see attachment 4.

3. Discount factor is calculated using (1+.20995)^1 = 1.20995, so for year 2 and forward (1+.20995)^2 and so on.

4. Discounted cash flow is calculated using 200 000.€ / 1.20995 = 165 296.09€, forward for years 2 through 10 and each year the NCF is divided by the discount factor for that year.

5. Net present value is calculated by adding together the individual year's discounted cash flow = 947 515.00€

So it is reasonable to estimate based on the income method's pricing techniques the value of the dry- technology. However, the most common error in applying the Income method is the failure to differentiate between the business enterprise value and the value of the technology asset that supports the business. It needs to be separated. (Anson 2010, 5.)

4.4.3 Relief from royalty method

This method measures the value by estimating future revenue associated with technology asset over its remaining economic life and then applying the appropriate royalty rate to the revenue estimate. Of course, if the technology asset generates revenue directly via licensing, the royalty stream is utilized in the valuation analysis techniques to discount estimated future royalties at an appropriate discount rate to arrive at a net present value NPV (Anson 2010, 6-7.) steps are as follows and the result is shown in table 7:

- Estimating current sales revenue to be used over a ten-year (10) period, based on historic sales from the case company: €1 500 000. x 10 = €15 000 000.

- Set a royalty rate range for the method by reviewing comparable industry royalty rates, at 7% (Heberden 2011, 13).

- Set the discount rate 20.995%, from discount rate analysis, attachment 4.

- Calculate future royalty revenues by applying the royalty rate determined in step 2 to estimated future sales revenues from step1:

€15 000 000 x 0.07 = €1 050 000.

- Discount future royalty earnings to a NPV using the discount rate determined in step 3 by the amount in step 4:

€1 050 000. / (1 + 0.20995) = €868 000.

Table 7. Result for the net present value (Anson 2010, 7).

Annual Revenue	€1 500 000.
Royalty Rate	7 %
Remaining Life	10 Years
Discount Rate	20.995%
NET PRESENT VALUE = €868 000.	

Over the course of the royalty agreement the case company would expect on an-average annually basis to be relieved from paying or to receive payment as a result of ownership of the asset; €1 050 000. / 10 years = €105 000. Plus any negotiated up-front payment.

4.4.4 Technology factor method TFM

As mentioned, this method is designed to measure the portion of a business's overall market value that is based on the utilization of the underlying unique technology (Anson 2010, 8). In this hypothetical example, Suzuki (2009) provides the necessary steps and questions to determine the upper limit, value and the weight and scores for the value and competitive attributes of the technology asset:

- In determining an asset's technology factor is to forecast the future cash-flow for the business using the technology. The present value of the cash flow can then be calculated by using a discount factor, which should include all potential risks associated with using the technology.

- Set an upper limit for the contribution of value provided by the technology. The upper limit of contribution is the maximum percentage of business value that can be credited to the asset. Since nearly every business has tangible assets in addition to intangibles, the upper limit for the contribution of the technological asset will be lower than 100 percent.

- Once the upper limit has been determined, create a list of the asset's strengths and weaknesses from the aspect of a hypothetical buyer and seller by placing them in two categories: value and competitive.

- Examples of questions to ask when thinking about strengths and weaknesses in the value category are:

    - At what stage of development is the technology?
    - Can the technology be mass produced?
    - How big is the market for the technology?

- Examples of questions to ask when thinking about strengths and weaknesses in the competitive category are:

    - Is there a risk of the technology becoming obsolete in the near future?
    - Are there similar technologies already in the marketplace?
    - Is the technology replacing another method or creating a new method for doing things?

- Weight and score the attributes on how a hypothetical buyer and seller would view them to determine the asset's attribute factor. Some attributes may increase value, while others may decrease value. Some may have no effect on value.

- Assign values from a range of +2 to -2, keeping in mind that higher numbers equate to a higher selling price which favors the seller, and lower numbers favor the buyer and a lower selling price.

- Score equivalents: -2 = 0, -1 = .25, 0 = .50, +1 = .75, +2 = 1.

- The equations for determining the Technology Factor are as follows:

    Upper limit x (weight x score) = attribute factor.
    Sum of attribute factors/sum of weights = Technology Factor.

Table 8. Answers received from questions 1, 2 & 9 by the interviewees which assisted in classifying the weight, attributes and score.

Questions:	**Answers:**
1) What are the most important factors (items) associated with the Battery Recycling Dry-Technology process?	Only recycling battery process that is Closed Loop so no environmental exposure / no smelting. Eco –friendly and exceeds the EU mandate.
1) When viewing the dry-technology as a potential saleable product to international customers, what would you consider to be its drawbacks?	Need customers for end product. Regulations inside the countries. Would not want to sell to larger industrial customers, because it would be loss as a real business. Best-selling: JV is probably the best way to sell the product or have. potential buyers of the technology similar in size as to the case company business.
9) Is there a marketing plan available for future plan to export technology/know-how to other countries close to battery suppliers? If so is it available for review.	Identified the markets of USA, India and China possibility for one facility in western Europe. No real market plan.

In the table, table 9, this technology asset has been scored a 70, meaning the business value attributable to this particular technology asset by a percentage, as informed by the case company.

- Multiply the technology factor by the asset's net present value to determine its value. *Assumption: The case company's future revenue based on the tenth year:

€1 500 000. x (1.05 ^10) = €2 445 000.

- Determined the upper limit of the dry- technology is 70%, so then the maximum revenue value will be:

€2 445 000. x 0.70 = €1 711 500.

- The revenue value has been established, now a value for the dry-technology asset needs to be calculated based on the TFM:

€1 711 500. x 0.595 = €1 018 350.

Table 9. The results from the technology factor method (Anson 2010, 8).

Upper Limit for the Case: 70			Calculation Formula:
Weight	Attribute	Score	(Upper limit x (weight x score)) = attribute factor
2	Stage of the Technology	+ 2	70 x (2 x 1) = 140
2	Competitive Market	+1	70 x (2 x .75) = 105
1	Environmental Aspects	+1	70 x (1 x .75) = 52.5
Technology Factor: (140 + 105 + 52.5) / 5 = 59.5			

4.5 Summary

There has been much research into valuation methods of technology assets and the four (4) real factors for technology pricing techniques include (Chiu & Chen 2007, 1046).

- Profitability of a technology, which includes the valuation methods and pricing techniques.

- Cost of research and development (R&D) which includes two sub-factors:

    - The seller knows more about the savings on cost, time, and risk.
    - The buyer mainly depends on the R&D cost.

- Overall sales transaction which can be estimated based on today's situation, the cost of absorbing specific knowledge about how the dry-technology and the battery recycling process and the recycling industry to make the transfer effective. There are also four factors which influence the sale transaction:

    - Characteristics of technology provider, any existing operations.
    - Characteristics of the technology asset, uniqueness & eco-friendly.

- How to apply the dry-technology by buyer; design process, technical and equipment specifications, documentation, controlling & reporting system, etc.
- The economic situation of the potential buyer and legal cost to structure the sales transaction.

From the qualitative analyses of the calculations from the pricing techniques, we can now compare the results, presented in table 10, that determined the realistic values of the dry –technology asset for each valuation method.

Table 10. Comparative results of realistic values

Pricing technique	**Cost base method - trending replacement**	**Income method - DCF***	**Relief from royalty method**	**Technology factor method**
Asset Value	€914 400.	€947 515.	€868 000.	€1 018 350.
Summary	Is often used only as a secondary method to measure the value of an asset. It is mentioned here, however, it should not be taken into the case company's business operation.	Is widely accepted by the business community, where specific income levels are used as input so a real value, output, can be determined on the asset value.	Is used where parties agree on specific income levels and/or on a royalty rate that can be identified for the given asset. This is a common approach to licensing the technology.	Is the most useful when it comes to the uniqueness of the technology asset, like with the case company's dry-technology which is eco-friendly and is the only one available on the market.

* Please note that the Discounted Cash Flow worksheet presented in this section is a simplified version for easy of understanding.

From the results, the income method DCF, the relief from royalty method and the technology factor method TFM are best suited for the case company's business operation and for the business model concept. However, at least two of the methods should be employed whenever a sales transaction is conceivable.

5 Discussion and recommendations

The valuation methods and pricing techniques have to be selected by; "who value", "why value" and "value what". The dry-technology asset value changes according to the way it is to be utilized in business (how), the time to value (when). The technology asset valuation methods and pricing techniques are rational estimations (what) by the case company and their expert consultant based on R & D, market, financial data and experiences. (Suzuki 2009.)

5.1 Findings and outcomes

Part of the thesis study analyses of the valuation methods and the pricing techiqnues provide clear aspects (Chiesa & Gilardoni 2005, 27.) for the case company when taken into practical use:

- Will force the case company to perform a systematic and rational analysis within the internal and external context of the valuation.
- Points out elements that could lead to a misleading and/or unusable valuation.
- Forces the case company to solve some critical trade-offs and to deal with contrasting elements internationally.
- Imposes coherence and consistency among the hypotheses and assumptions needed to finally identify a value(s).
- Gives to the case company an excellent communication tool, as many different people are involved during the potential sales transaction.
- Allows potential buyers and others to understand how the value of the asset has been determined and the validity and reliability of the results.
- Increases the bargaining power of the case company during the sales negotiation with potential buyer(s), allowing a clear and complete understanding of the value of the asset.

For contractual relations (sale transaction) it is important to develop a "starting point" for negotiation even if there may be a reasonable difference in the projection of the value, it is an advantage to be able to show reasoning behind the valuation method for this dry-technology asset.

5.2 Recommendations and future works

Based on the results and summary of the works presented in section 4.5, the recommended valuation methods (Anson 2010, 6- 8) with its respective pricing technique to be taken into use in the case company business operation are:

- Income method using Discounted Cash Flow (DCF) seems to be the best useful tool, which is also widely accepted by businesses. The usefulness of this method takes into consideration the Time – to bring the technology on the market, the Money – investing into market research, marketing plans, etc. Risks – hedging the volatilataty of metals market, foreign currency exchanges and patent infrigement protection.

- Technology factor method seems upfront to be a more complicated process, however, once the management can make necessary decisions to deterime the value percentage of the unique dry-technology asset as weighted in the business operations, the weight of the value and competitive attributes, this method usefulness will be advantageous to the case company when valuing its technology assets.

- Relief from royalty method is in basic a simply method, however, it must take into use the DCF calculation for the projected revenue and to settle on an appropriate discounted rate. This method usefulnesss will be taken when the opportunity arises for the case company to have a licensor –licensee sale transaction or in the formation with a joint venture partner.

These methods will provide the "starting point" based on availability of data and the annual financial statements. From these valuation methods what most matters is the accuracy of the estimations and assumptions about whether the dry-technology asset taken into use in a business model concept will be a success and how much are other companies willing to pay to conclude the sales transaction. (Potter 2007, 811.)

The recommended valuation methods and pricing techinques can be formatted for the required detail of data, figures, formulas and steps that can be created by using excel

worksheets and/or templates as the working tools, see attachment 4. There may be the possibility of intregration with the case company's Mircosoft® Access program reporting system. However, more research will be needed.

5.2.1 Recommeded future works

Two **red flag** issues arisen from the interviews conducted and from the answers provided by the executives and expert consultant from the questionnaire.

Red Flag 1. From Question 9: Is there a marketing plan available for future plan to export technology/know-how to other countries close to battery suppliers? If so, is it available for review? Answer: No marketing plan exists.

Recommendation; the marketing plan is vital working tool that needs to be created for the case company. The marketing plan will support the business model concept and it should be based on the following main points:

- Only dry-technology available on the market.
- Profitable business, an existing battery recycling facility that produces renewable metals as its final product.
- An active network of suppliers and potential buyers.
- 100% clean technology (environmental friendly) and saves on natural resources.
- The Mircosoft® Access program which has been developed, a very important tool and a great selling point.

Red Flag 2. From Question1: What are the most important factors (items) associated with the Battery Recycling Dry-Technology process? Answers: Only recycling battery process that is closed loop so no environmental exposure and no smelting. Eco – friendly and exceeds the EU mandate.

A deep concern grew from the researching, in some countries the environmental aspect is not taken into consideration at all in the sales transaction. The buyers are only concern with how much can the technology asset produce (volume) and how much

income (money) can be derive from the renewable metals on the market place. The environmental value method was not taken into this thesis study, based on answers and advice in section 4.3, page 26.

Recommendation, in the best interest of the case company, a project study needs to be carried out to find the best suited environmental value method along with a reliable pricing technique. Due to time constraint, this valuation method could not be taken into this thesis study. This project study would be beneficial as to determining a realistic value for the dry-technology asset from the environmental cause. Also, it is a great marketing tool of which can be used in marketing & sales plan. High quality, reliable documentation and data exists and by doing so, the case company will receive a positive return on its investment.

5.3 Reflection, professional development and learning

The researching that goes into a thesis study could be endless, so limitations must be taken into consideration. As for this thesis, the limitation was on how calculation were completed and presented. In the real world, for example, the DCF worksheets are more complex and detailed as to the data that goes into the figures used.

The detail to research seems to be the key when writing the thesis report. The thesis study is an excellent learning process for anyone. However, this thesis was written in a manner to keep it as much as possible for its interesting topic, easy of reading and the simplicity to understand.

The case company's chairman and the thesis author had met on several occasions to discuss the progress and content of the thesis. The chairman has been satisfied to-date. However, a final presentation/discussion meeting has not yet happen. The executives and their expert consultant whom were involved in the thesis study are great people and many thanks go out to them for their help and advice. The hope is that the recommendations given in this thesis study brings a real value to the case company's business operation.

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Attachments

Attachment 1. Questionnaire for the case company's executives

Interviews conducted, 04.02.2014 Page 1 of 2

General questions about the dry technology:

1) What are the most important factors (items) associated with the Battery Recycling Dry-Technology process?

2) When viewing the dry-technology as a potential saleable product to international customers, what would you consider to be its drawbacks?

3) What is the status of the patent?

Questions on the valuation methods:

4) What is your opinion or what methods has the company considered as to the valuation process to be used for pricing techniques of the patent dry-technology asset?

   - Cost method: The pricing of a product is based on the cost of developing the product. This approach is rarely used to assign a value to a technology because the *cost* of research is not usually correlated with the *value* of the intellectual property that was the basis for the technology.
   - Income method: The value of a technology is determined by a pure income approach, whereby future anticipated revenues (cash flows) are discounted to present value.
   - Market method: The value of a technology is determined based on the value of a similar or comparable technology. The inherent weakness of this method is that it is difficult to find a comparable technology if the technology in question is truly novel
   - Technology Factor method: directly measuring the contribution of the technology to the total revenue of the business. The technology factor method can be used on one technology at a time to eliminate the limitations of the excess earnings method.
   - Royalty rate method: The value of the technology asset is calculated as the present value of the royalties that the company is relieved from paying or to receive payment as a result of ownership of the asset. It measures value by estimating future revenue associated with the asset over its remaining economic life and then applying an appropriate royalty rate to the revenue estimate.
   - Environment Life Cycle Cost Analysis: Is a technique for assessing the potential environmental aspects associated with a technology/product by gathering an inventory of relevant inputs and outputs, evaluating the potential environmental impacts associated with these inputs and outputs, and interpreting the results.

5) Has any valuation been done on the patent as to its value? If so, is any documentation available for review?

Question pertaining to formulation of the Pricing Techniques:

6) The dry-technology process flowchart informs of the process in phases, total of 8, in your opinion is it best to explain the phases in somewhat detail and do the valuation/pricing phases by phase (if possible) or use a more general process description and have the valuation method and pricing technique completed as a whole? Provide an explanation as to your reasoning.

7) Business model concept: Would a Turnkey Solution Package producing a renewable final product be right for this concept?

8) Any previous sales transactions as pertaining to the patent licensing of the dry technology. With whom, when, offering price, sales negotiations of final price, how was the sale transaction completed, any other information?

Concluding question:

9) Is there a marketing plan available for future plan to export technology/know-how to other countries close to battery suppliers? If so is it available for review.

Attachment 2. Questionnaire for the case company's expert consultant

Interview conducted, 13.02.2014 Page 1 of 2

General questions about the dry technology:

1) What are the most important factors (items) associated with the Battery Recycling Dry-Technology process?

2) When viewing the dry-technology as a potential saleable product to international customers, what would you consider to be bestselling points and/or drawbacks? Drawback:

3) What is the status of the patent process?

Questions on the valuation methods:

4) What is your opinion(s) and to what methods have you, the expert consultant, considered as to the valuation(s) to be used for pricing techniques of the patent and dry-technology process?

   - Cost method
   - Income method
   - Market method
   - Hybrid method (Technology Factor)
   - Royalty relief method
   - Environment Life Cycle Cost Analysis
   - Others that could be presented in the thesis?

5) Has any valuation been done on the patent and the dry technology as to its value? If so, please inform as to which valuation method, is any documentation and calculations available for review?

Question pertaining to formulation of the Pricing Techniques

6) The dry-technology process flowchart informs the process in phases, total of 8, in your opinion is it best to explain the phases in somewhat detail and do the valuation/pricing phases by phase (if possible) or use a more general process description and have the valuation method and pricing technique completed as a whole? Provide an explanation as to your reasoning.

7) In your opinion what is the best sales solution for the dry technology Business Product Model (see the attached model presented by the case company)? A turnkey type solution or a technology processer only solution? Please if possible explain in detail.

8) Any previous sales transaction as pertaining to the case company's patent licensing of the dry technology? With whom, when, offering price, sales negotiations of final price, how was the sale transaction completed, any other information? Follow-up; if not, have you followed any case study of a similar product(s)?

Concluding questions

9) Is there a marketing plan available for future plan to export technology/know-how to other countries close to battery suppliers? If so is it available for review.

Attachment 3. Questionnaire and interviews

Table 2. Questions and Answers from questionnaire and interviews

Questions Presented:	**Answers: Consensus from the interviewees**
1) What are the most important factors (items) associated with the Battery Recycling Dry-Technology process?	Executives; eco –friendly and exceeds the EU mandate. Expert; only recycling battery process that is Closed Loop so no environmental exposure / no smelting.
2) When viewing the dry-technology as a potential saleable product to international customers, what would you consider to be its drawbacks?	Executives; Need customers for end products. Regulations inside the countries. Expert; would not want to sell to larger industrial customers, because it would be loss as a real business. Joint venture (JV) is probably the best way to sell the product. Have buyers of the technology asset similar in size as to the case company.
2) What is the status of the patent?	Executives; to be announced and granted. Expert; View what is available.
4) What is your opinion on what method(s) has the company considered as to the valuation to be used for pricing techniques of the patent and dry-technology process?	
Cost Method	Executives stated as most important, however, Expert disagreed stating it brings no real value to the technology.
Market Method	Executives' answers were mainly about a fail attempt by a French company to develop a similar technology. Expert stated new technology so no market for comparison.
Income Method	Executives, cash flow discount needs to be valued. Expert, in use with inputs from the existing operations.
Relief form Royalty Method	Executives and Expert all agreed if handle as a licensing transaction, however, concerns about patent infringements in the BRIC countries.
The Technology Factor Method	Executives would like to have more information on this method with formula(s). Expert would like to have in use in the future.
Environmental Value Method	Executives were interested to know more, however, Expert stated "no interest from the potential buyers in the market". Main reasons are; too complicated and complex to conduct a valuation and set a realistic price. It was recommended by the expert to keep out this method from the thesis study because of the complexity of valuation and lack of real data.
Others that could be presented in the thesis?	Expert; a hybrid method, combining market and income methods, in the future.

5) Has any valuation been done on the patent as to its value? If so, is any documentation available for review?	Executives; It seems that the Expert has already done the valuation based on the cost method approach and the Income method, documentation is limited and will be made available for review. Expert's concern was that no comparison will happen between the real on-going calculations and what is presented in the thesis study of the Income method.
6) The dry-technology process flowchart informs the process in phases, total of 8, in your opinion is it best to explain the phases in somewhat detail and do the valuation/pricing phases by phase (if possible) or use a more general process description and have the valuation method and pricing technique completed as a whole? Provide an explanation as to your reasoning.	Executives; The flowchart is confidential, so use limited text from the patent documentation. Expert; Use what was agreed from executives.
7) In your opinion what is the best sales solution for the dry technology Business Product Model; A turnkey type solution or a technology processer only solution? Please if possible explain in details.	Executives; The company does not want to sale a turnkey type solution. Technology Processer only! Monies invested into R & D, most important. Expert; informed that the technology process responsibility starts at the gate fee as showed in the business model. Also the business model must be discussed in detail with the case company executives.
8) Any previous sales transaction as pertaining to the case company's patent licensing of the dry technology? With whom, when, offering price, sales negotiations of final price, how was the sale transaction completed, any other information? Follow-up; if not, have you followed any case study of a similar product(s)?	Executives; No actual sales Expert; Currently working a JV agreement with a potential partner (buyer). No details are available.
9) Is there a marketing plan available for future plan to export technology/know-how to other countries close to battery suppliers? If so is it available for review.	Executives; Have identified the markets of USA, India and China but no real marketing planning. Expert; No marketing plan available.

Attachment 4. Discounted rate analysis

Risk Free Rate, Rf	**3.301%**	**(a)**
Expected Market Return, Rm	**12.224%**	**(b)**
Equity Beta	**0.70%**	**(c)**
Market Risk/Size Premium	**4.75%**	**(d)**
Total for the Discount Rate	**20.995**	

(a) 10-years yield on ECB treasury bonds year end 2013 (europa 2014).

(b) Historical expected market return (volatility, from the case company pervious FS).

(c) Subjective judgment as determined by appraiser (valuatum 2014).

(d) Traditional, subjective judgment as by appraiser (valuatum 2014).

Sources:

Europa. 2014. EBC treasury bonds. URL: http://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=143.FM.M.U2.EUR.4F.BB.U2_10Y.YLD. Accessed: 5 Apr 2014.

Valuatum. 2014. WACC - Parameter guidance. URL: http://www.valuatum.com/supportportal/component/content/article/45-support-documents-by-category/wacc-and-valuation/85-wacc-parameter-guidance.html. Accessed: 5 Apr 2014.

DISCOUNTED CASH FLOW

INITIAL OUTLAY/INVESTMENT	€ 900,000.00
DISCOUNT RATE	20.99%

Growth rate on average: 5.0%

Years:	1	2	3	4	5	6	7	8	9	10
	€									
Cash Flow	200,000.0	210,000.0	220,500.0	231,525.0	243,101.3	255,256.3	268,019.1	281,420.1	295,491.1	310,265.6
Discount Factor	1.2099500	1.463979	1.7713414	2.1432345	2.593206607	3.1376503	3.7964	4.5934542	5.5578499	6.7247205
* Discount rate	20.995%									
Discounted Cash Flow	165296.09	143444.68	124481.93	108025.98	93745.42	81352.696	70598.23	61265.46	53166.44	46138.07

NPV

947515.00

€ 947,515.00 Value of the Technology

Risk Free Rate, Rf	3.30%	(a)
Expected Market Return, Rm	14.42%	(b)
Equity Beta	0.50%	(c)
Market Risk/Size Premium	2.77%	(d)
Total for the Discount Rate	20.99%	

(a) 10-years yield on ECB treasury bonds year end 2013

(b) Historical expected market return, pervious FS

(c) Subjective judgment as determined internally or by appraiser

(d) Traditional, subjective judgment determined internall or by appraiser

Source: valuatum 2014

1. Net cash flow for year 1 is based on the company's financial statements for the previous year 2012, year 2 to 10 projecting a growth rate at an average of 5%.
2. Discount rate is formulated by using factors with corresponding percentages developed in the discount rate analysis, see attachment 4.
3. Discount factor is calculated using (1+.20995)^1 = 1.20995, so for year 2 and forward (1+.20995)^2 and so on.
4. Discounted cash flow is calculated using 200 000.€ / 1.20995 = 165 296.09€, forward for years 2 through 10 and each year the NCF is divided by the discount factor for that year.
5. Net present value is calculated by adding together the individual year's discounted cash flow = 947 515.00€

Relief from Royalty Payment

INITIAL	0.00 €
DISCOUNT RATE	20.995%

			Year 1	Year 10	Total amount of royalities	Net Present Valueof royalties
1	Based year's annual reveunue		1,500,000.00 €			
2	Potential annual growth rate	0				
3	Projected accepted life of the asset	10		15,000,000 €		
4	Royalty rate; industry standard	7.0%			1,050,000 €	
5	Discounted rate	20.995%				
6	Total amount of present day royalties					**867,804 €**
7	Average annual relief from royalty payment				105,000 €	

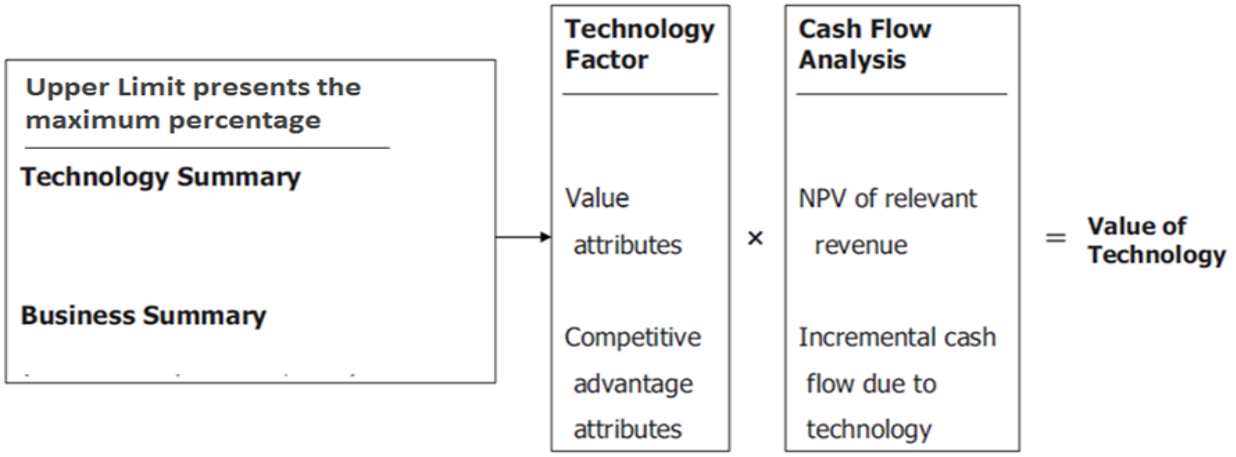
Risk Free Rate, Rf	3.300%	(a)
Expected Market Return, R	15.190%	(b)
Equity Beta	0.500%	(c)
Market Risk/Size Premium	2.005%	(d)
Total for the Discount Rate	20.995%	

(a) 10-years yield on ECB treasury bonds year end 2013
(b) Historical expected market return, pervious FS
(c) Subjective judgment as determined internally or by appraiser
(d) Traditional, subjective judgment determined internall or by appraiser

Technology Factor Method

1 **Formula Form**

This factor is determined by establishing an upper limit for the contribution of value provided by the technology asset used in a particular process and then performing a relative strength analysis via various value and competitive attributes, to narrow the contribution of the technology to a specific percentage within that upper limit (Anson 2010, 8).



2 **The upper limit:**

The upper limit represents the maximum percentage of total business value that can be attributed to the dry- technology asset as in the case of the recycling of batteries which the final renewable products features a large contribution.
Meaning, a relatively high upper limits. Contribution is the maximum percentage of business value that can be credited to the asset. Since nearly every business has tangible assets in addition to intangibles, the upper limit for the contribution of the technological asset will be lower than 100 percent.

Questions:

Upper limit in percentage:		100.0%
2.1	What percentage of the tangible asset related to the intangible asset?	23.5%
2.2	What percentage of other intangible asset(s) contribute to the business's revenue?	0.0%
2.3	What percentage of other business transsactions contribute to the business's revenue	6.5%
	Total contribution of the upper limit	**70.0%**

3 **Strenghts and Weaknesses:** From the aspect of a hypothetical buyer and seller by placing them in two attribute categories:

Score equivalents:		-2 = 0, -1 = .25, 0 = .50, +1 = .75, +2 = 1	Scale:	-2 to a + 2	
Value:					**Score:**
Questions:	3.1	At what stage of development is the technology?	In use	2	1
	3.2	Can the technology be mass produced?	No. limited due to the raw materials	-1	0.25
	3.3	How big is the market for the technology?	Open, internationally	2	1
	3.4	Is there a marketing plan being utilized?	No	-2	0
	3.5	Environmental Aspect of tech. in sales?	Limited. Tough for buyer to put price	-1	0.25
Competitive	3.6	Is there a risk of the technology becoming obsolete in the near future?	Yes, within 10 or more years	0	0.5
	3.7	Are there similar technologies already in the marketplace?	No.	2	0.5
	3.8	Is the technology replacing another method or creating a new method for doing things?	Both, EU directive 2006	1	1

4 **Technology Factor Rate:**

	Upper Limit for the Case:	70.0%	Calculation Formula:		
Weight	Attribute	Score	(Upper limit x (weight x score)) =		Attribute factor
Value:					
2	Technology development	1	0.70	2	1.40
-1	Technology mass produce	0.25	0.70	0.25	0.18
2	Market size	1	0.70	2	1.40
-2	Marketing Plan	0	0.70	0	0.00
-1	Environment Aspect	0.25	0.70	0.25	0.18
Competive:					
0	Risk of obsolete	0.5	0.70	0.5	0.35
2	Similar techn. In market	0.5	0.70	1	0.70
1	Replacing existing or new	1	0.70	1	0.70
	Technology Factor:	**4.90**	**8**		**0.61**

5 Pricing Technique:

***Assumptions**

1	Future revenue based on projected growth for the tenth year:	1,500,000 €	1.628894627	2,443,342 €
2	The upper limit x the maximum revenue value:	2,443,342 €	70.0%	1,710,339 €
3	The revunue value of the dry-technology asset x the Technology factor rate:	1,710,339 €	0.61	1,047,583 €
	Value of the Dry-technology asset:	**1,047,583 €**		