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A Consistent Implementation of IFRS 13 and IAS 36 for Non-current Assets

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Abstract.
There is much debate for both the academic community and accounting professionals with respect to the use of fair value and cost accounting, as well as the application of impairment to current and non-current assets. Fair value and impairment are two related concepts, the reason being that in order to proceed with the latter, the current market price of an asset should first be measured. IAS 36 came into force to stipulate that no asset should be valued above its current actual value. Assets' revaluation affects not only the companies' outcome but also the applied depreciation method, which must be adjusted accordingly to the new data. Assets that cannot be measured to their fair value, in accordance with the IAS instructions, are grouped to form identifiable units within the company that was able to generate cash inflows and be tested for impairment as a whole. In this article, we focused on presenting a methodology from a technical approach on these issues, whilst at the same time remaining compatible with the principles of both accounting and finance. Real-life data from existing companies have been used not only for the valuation of the same following their transformation into cash-generated units, but also for non-current assets by controlling both the impairment and the depreciation process. We use cash flow generation models through the business plan process and apply certainty and uncertainty techniques such as sensitivity analysis and Monte Carlo simulation. After having reviewed the estimations and bearing in mind the structure of the model, we have concluded that specific parameters are affecting the fair value measurement on non-current assets. The value of this article is to develop a methodology that can be easily applied to different companies and is compatible with the spirit and provisions of both the international accounting standards as well as those of financial accounting.

Keywords: FVA, cost accounting, finance, impairment, OR

jel CLASSIFICATION codes

C67; G32; M41

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1. INTRODUCTION

The measurement of fair value for an entity is an important issue in the sciences of accounting, finance, business administration, mergers and acquisitions, business strategy and investment decision making.

This valuation is required to be constantly on the market and the measurements of financial health and creditworthiness of companies depend on it.

In this article, we focus primarily on the valuation that constitutes the applied Accounting Reporting Framework for companies such as IFRSs and US Accounting Standards. This section provides the required terminology and business valuation process on a case-by-case basis.

The literature review and the accounting framework for the measurement of fair value are then provided.

After the above analysis of the measurement framework of the fair value the paper focused on the case of a CGU cash-generating unit, where the input data is level 3, the fair value is assessed or found using the VIU value in use method and the income approach is used to find fair value.

We then associate accounting with financial and mathematical operational research techniques such as the Monte Carlo simulations.

Before a CGU is valued and in accordance with International Accounting Standards (IAS) 36, there must be a Trigger of impairment. Each entity must establish in its accounting policies valuation methods and disclose how the indication of impairment is made. In this article we develop a novel impairment testing method based on EVA that can be applied for impairment testing of a CGU or a whole company.

Case studies are developed for trigger of impairment and for valuation of a CGU or Company. Finally, we are applied to these Monte Carlo simulations, especially when we have cases where the inputs are level 3.

2. The valuation's accounting framework

An accounting procedure under International Accounting Standard (IAS) 36 for the impairment of a company's assets should follow the diagram below:

If Trigger of Impairment does not exist, then Carrying Amount (CA)

Otherwise See below:

The Carrying Amount (Ca) compare with Recoverable Amount (RA)

Where,

RA = MAX [Fair Value Less Costs to Sell (FVLCS), Value In Use (VIU)]

If CA < RA: No impairment

Else: CA declined to the amount of RA i.e., CA – RA

In addition, IFRS 9 requires an impairment test under IAS 36 which, in addition to Individual Assets, also allows for an impairment test on a Cash-Generating Unit (CGU) and ultimately business entities.

After a company valuation (measurement of fair value), the carrying amount is impaired in the parent company's books with the recoverable amount or value in use provided. If this value is lower than the current book value, the books of both the parent and the group are adjusted accordingly based on the combination of the provisions of IAS 27 & 28 as well as IFRS 10.

In a valuation of an unlisted company's value (ie a company unlisted for trading on its equity securities in a regulated market - Stock Exchange), is calculated based on the provisions of IAS 36, IFRS 13 and IFRS 9. IFRS 9 requires entities to value all investments in equity securities at fair value, even if those instruments are unlisted on an active market.

Fair value less costs to sell (FVLCS) is the amount that can be obtained from the sale of an asset in a transaction between well informed and willing parties, less disposal costs.

For Value In Use (VIU) we concentrate at methodologies following Level 3 inputs. Level 3 inputs are unobservable inputs for the asset or liability. [IFRS 13:86] Unobservable inputs are used to measure fair value to the extent that relevant observable inputs are not available, thereby allowing for situations in which there is little, if any, market activity for the asset or liability at the measurement date. An entity develops unobservable inputs using the best information available in the circumstances, which might include the entity's own data, considering all information about market participant assumptions that is reasonably available [IFRS 13:87-89],

IFRS 13 does not contain a hierarchy of valuation techniques, nor does it propose the use of a specific valuation technique to achieve the objective of measuring fair value.

IFRS 13 describes three valuation approaches (see paragraphs B5 - B33 of IFRS 13):

1. the market approach, the market approach uses prices and other relevant information generated by market transactions involving identical or comparable assets (see paragraph I5 of IFRS 13). Some techniques are consistent with the market approach. The most used market approach techniques for valuing unlisted equity securities are

related to the data sources they use (e.g. The following market approach techniques are:

a. transaction price paid for an identical or similar instrument of an investor and

b. comparable valuation multipliers of companies derived from disclosed data (ie multipliers-indexes of listed companies) or from prices paid in transactions such as mergers and acquisitions.

2. the income approach, the main method is that of discounting the expected cash flows Discounted cash flow (DCF) method mentioned above for the calculation of value in use (VIU). Other methods are dividend discount or Gordon - Dividend discount model (DDM), the capitalization method that uses the PER or P / E earnings ratio. All methodologies above are widely provided by works of [1]–[10]

3. the method of adjustments of the Adjusted net asset method and finally

It is generally the case that the recoverable amount should be determined for the individual asset, if possible. [IAS 36.66]

If it is not possible to determine the recoverable amount (that is, the higher of fair value less costs to sell and value in use) for the individual asset, then the recoverable amount for the cash- generating unit (CGU) is determined. [IAS 36.66] The CGU is the smallest identifiable group of assets that generates cash inflows that are largely independent of cash inflows from other assets or groups of assets. [IAS 36.6] or may be withdrawn.

The calculation of value in use should reflect the following elements: [IAS 36.30]

1. an estimate of the future cash flows that the entity expects to derive from the return on its assets
2. possible fluctuations in the amount or duration of these future cash flows
3. the time value of money, represented by the current interest rate without market risk,
4. the price that carries the uncertainty that exists in the returns of assets and other factors,
5. such as liquidity, which market participants will reflect in the pricing of future cash flows that the entity expects to derive from the use of its assets.

Cash flow projections should be based on reasonable and supportable assumptions, the most recent budgets and forecasts, and extrapolation for periods beyond budgeted projections. [IAS 36.33] IAS 36 presumes that budgets and forecasts should not go

beyond five years; for periods after five years, extrapolate from the earlier budgets. [IAS 36.35] Management should assess the

reasonableness of its assumptions by examining the causes of differences between past cash flow projections and actual cash flows. [IAS 36.34]

Cash flow projections should relate to the asset in its current condition – future restructurings to which the entity is not committed and expenditures to improve or enhance the asset's performance should not be anticipated. [IAS 36.44]

Estimates of future cash flows should not include cash inflows or outflows from financing activities, or income tax receipts or payments. [IAS 36.50]

In measuring value in use, the discount rate used should be the pre-tax rate that reflects current market assessments of the time value of money and the risks specific to the asset. [IAS 36.55] The discount rate should not reflect risks for which future cash flows have been adjusted and should equal the rate of return that investors would require if they were to choose an investment that would generate cash flows equivalent to those expected from the asset. [IAS 36.56]

For impairment of an individual asset or portfolio of assets, the discount rate is the rate the entity would pay in a current market transaction to borrow money to buy that specific asset or portfolio. If a market-determined asset-specific rate is not available, a surrogate must be used that reflects the time value of money over the asset's life as well as country risk, currency risk, price risk, and cash flow risk. The following would normally be considered: [IAS 36.57]

1. the entity's own weighted average cost of capital
2. the entity's incremental borrowing rate
3. other market borrowing rates.

In the income approach, the main method is Discounted cash flow (DCF) method mentioned above for the calculation of value in use (VIU). Other methods are dividend discount or Gordon - Dividend discount model (DDM), the capitalization method that uses the PER or P / E earnings ratio. By using this method, the methods of finance science enter the accounting of fair value.

3. Literature Review

The implementation of SFAS 157 in the US provides a useful background in which IFRS 13 is based. US-based evidence with respect to FVM under SFAS 157 (ASC Topic 820)

indicates that disclosure of such information is deemed useful by market participants (ie investors and financial analysts). However, it also appears that, depending upon their incentives and underlying motivation, managers can take advantage of FVM to either deceive market participants or to convey private information to the market about the value of underlying securities. In addition, the meaning of estimates across the three FV levels is not always straightforward as it depends on the type of assets or liabilities in each level, which then defines the characteristics of the valuation inputs (eg obtained from illiquid markets), and on managerial incentives. FV is a measurement base built around a theoretical framework consistent with the Conceptual Framework of the FASB and IASB [11]. The majority (70%) of FV estimates rely on market inputs (Level 2), with market prices (Level 1) representing 23.5% of FV estimates and model. based estimates (Level 3), only 6.5% of FV estimates [12]. Investors assign different valuation coefficients depending upon the hierarchy level being used [13]. A sample of US closed-end investment funds with significant proportions of level 3 FV assets in total assets, and note that Level 3 FV are more informative about securities' future cash flows and more predictive of future stock returns than Level 1 and Level 2 FV [14]. There are evidence that is consistent with levels reflecting liquidity risk [15]. High Level 2 and 3 estimates are related to higher conservatism in accounting numbers [16]. Level 3 FVM are related to a greater likelihood to meet or beat earnings forecasts made by financial analysts [17]. The paper only focuses on Level 3 assets which the authors view as more prone to manipulations, ie managers have more flexibility in such measurements and therefore the expectation is for a positive relation between the disclosed amount of Level 3 FVM and the odds of recognizing unrealized gains to meet or beat analyst forecast target. Accounting restatements are used as a proxy for financial reporting quality [18]. The authors argue that Level 3 FV assets may contain significant measurement errors and may induce managerial manipulation. The speed to which Business Development Companies (BDCs) update the FV of their investments [19].

After the implementation of IFRS 13 in Europe several studies are produced. The first year of IFRS 13 implementation and includes listed real estate firms from Italy, Germany and France [20]. After IFRS 13 implementation (2013–2014), real estate firms in the EU provide significantly more items as disclosure for Level 3 FVM compared to the period prior to IFRS 13 implementation [21]. The stock market decreases its discounting of closed- end funds' market values when funds disclose the significant unobservable inputs and the valuation techniques used to estimate Level 3 FV [22]. Due to the subjectivity and uncertainty in FV estimates, less precise FV estimates may

not necessarily be viewed as less reliable [23]. A number of issues with the application of IFRS 13 valuation techniques to measure the FV of private equity [24].

Three key takeaways arise from the above review of prior research. First, the disclosure of the FV hierarchy underlying FV estimates (vs. a situation of no disclosure) is beneficial to capital markets' participants such as investors and financial analysts. It allows them to be more precise in their valuation of a firm and in the forecasting of its future earnings. Second, regarding specific FV levels, the ranking which is explicit in the hierarchy (ie Level 1 > Level 2 > Level 3 in terms of relevance or faithful representativeness) does not appear to be stable. Some studies provide evidence that is consistent with value relevance, informativeness and reliability being higher for Level 1 (Level 2) vs. Levels 2 and 3 (Level 3). However, such evidence is conditional upon the liquidity/riskiness of assets being measured, their complexity, and uncertainty surrounding the measurement process and market conditions. Hence, greater details in disclosure may lead to some confusion in the market. Third, depending upon their incentives, including the governance to which they are subject, managers will take advantage of their measurement discretion to either inform financial statements users (and thus increase the quality of reporting) or to deceive them (eg to achieve some earnings targets). In this regard, it is noteworthy to mention that no paper discusses and analyses the process by which FV estimates are arrived at. Such process is deemed important by market participants, but their insights are limited to what is currently being voluntarily disclosed [25]. Investors may need a better understanding of this process, which will allow them to adjust their reliance on FV estimates.

In the above dialogue our paper is attempted to contribute by a clear and transparent methodology which easily will be disclosure in companies' annual financial statements.

Fair value measurement is considered with Fair Value and Amortized cost for property assets in the work of [26], [27]Operational Research Models are Used in study

4. uncertainty and risk

When the data inputs are level 3 and the future cash flow data are generated using internal data and feasible and observable assumptions - the uncertainty enters the model.

For the purposes of this article, we have selected the PERT and UNIFORM distributions functions for inputs and the Monte Carlo simulation for calculation VIU in order to introduce the uncertainty and risk on the cash flows of the business plan and in discount factors on VIU calculation.

4.1. MONTE CARLO SIMULATION

Monte Carlo simulation, or probability simulation, is a technique used to estimate uncertainty's & risk's impact in financial forecasting models, particularly in business plans and investment valuations. It is a mathematical technique that generates random variables for modelling risk or uncertainty of a certain system. All inputs are formulated to follow a certain propability distribution. Using a random number machine on a computer, the outcome is simulated using different values as inputs. The same method runs using a fairly large number of tests, and at the end the occurrence rate of each result is calculated. Monte Carlo Simulation nowadays, [28] is considered one of the most viable ways of capturing risk especially in complex models where there is an element of uncertainty. It is a probabilistic method for modelling risk in a system and It is never deterministic. Monte Carlo simulation performs risk analysis by building a model of possible outcomes using a range of values (probability distributions) for each factor with inherent uncertainty. Depending on inputs propability distribution (normal, lognormal,Pert,uniform etc.) the outcome is diferrent. The Monte Carlo method is better at predicting possible outcomes, as well as estimating how likely is each one. This is helpful when modeling variables that are related (or potentially related), like in gambling or risk taking. In essence, using this method we can reproduce the result of a model using multiple simulations and values that are reproduced and follow the distribution that we have defined. In this way we record the outcome each time and create a probability set of occurrence of each outcome. By using different distributions, the probability of occurrence of each outcome can be changed. Using distributions is a way to describe the uncertainty and risk inherent in the model under consideration. An option for generating numbers for Monte Carlo simulation is the usage of Latin Hypercube sampling, which is used from Palisade's @RISK, i.e the software used in said article. It is a statistical method for generating a near-random sample of parameter values from a multidimensional distribution. The sampling method is often used to construct computer experiments or for Monte Carlo integration. Latin Hypercube sampling one must first decide how many sample points to use and for each sample point remember in which row and column the sample point was taken. The probability that the actual return will be within one standard deviation of the most probable ("expected") rate is 68%; that it will be within two standard deviations is 95%, and that it will be within three standard deviations is 99.7%. Still, there is no guarantee that the most expected outcome will occur, or that actual movements will not exceed the wildest projections.

Two book that provide a wide variety of knowledge about monte carlo simulation are [29], [30].

4.2. Uniform

In uniform distribution occurance of each value is the same. The user needs to define the min (α) and max (b) parameter (value, percentage, rate etc.) in order to limit the range of results that will be obtained . Since each effect in a uniform distribution [31] occurs with the same relative frequency, the resulting shape of the distribution is that of a rectangular. An idealized random number generator would be considered a continuous uniform distribution. By choosing a uniform distribution and limit the sample between a required range, each generated input value has the same propability of occurance no matter how many times the selection is made. Using this distribution for multiple runs in the defined range, the values of lower and higher chances of occurrence can be found. Today, almost all statistoc softwares give the ability to generate numbers following the said propability.. If u is a value sampled from the standard uniform distribution, then the value a + (b − a)*u follows the uniform distribution parametrized by a and b, as described above.

4.3. PERT

Pert distribution belongs to the category of the continuous probability distributions [32]. In this distribution the minimum, most likely and maximum values are defined, and the mean is calculated as the weighted average of said values. It shares a lot of common characteristics with the triangular distribution [33] but the values produced create a more normalized curve. Moreover, triangle distribution uses the same weight to all values, i.e extreme values, thus the expected value is less reliable than in pert. This transformation in order the outcome be less sensitive in some parameters, is widely used in sensitivity analysis in order to better capture uncertainty and risk. The standar deviation, although comple to calculate, is less sensitive to extreme values and more reliable when trying to measure risk and possible outcomes.

In modelling it is often necessary to use estimates on some parameters where the exact values are not available. In order to create a probabilistic model (such as a Monte Carlo simulation), using the pert distribution the estimates are generated based by choosing the three schenarios (the minimum ,maximum, and the ”most likely” value). Once the probability distibution is ready, [34] Monte Carlo simulations can then be run

based on samples from that distribution. When multiple estimates are available, you can model the distribution in several different ways to generate sample values.

Assuming that many real-world phenomena are normally distributed, the appeal of the PERT distribution is that it resembles a normal distribution when it is symmetrical, or when the mode is halfway between the minimum and maximum. Pert distribution is a reliable tool to almost all statistic softwares. In combination with the Monte Carlo simulation, the PERT distribution is very usefull to estimate risk under complicated situations. One important note is that the distribution depends on the chosen values, thus the fisrt stage is very important in order to generate reliable outcomes.

5. Trigger of Impairment of a CGU based on EVA

Trigger of Impairment testing is important for an individual asset, a group of assets and for a company. An asset, according to international accounting standards and all accounting standards, is stated to be anything that generates future cash flows. Thus, cash flows are generated by an asset, a CGU (Cash Generated Unit) and a company. A different and more important way of indicating a trigger of impairment of a CGU will be analyzed, in this chapter, as well as the amount of the possible impairment with a detailed mathematical justification. Finally, a complete CGU, photovoltaic plants with real data from a company based in Greece, example will be analyzed. In this example, firstly, will be performed a test for possible impairment using EVA (Economic Value Added) for each CGUs. Then the amount of impairment will be determined in two different ways of estimation: 1) using the EVA negative percentage in WACC and 2) using the DCF (Discounted Cash Flow) method which is identical to the VIU method proposed by international accounting standards. These two methods should be financially identical, but EVA is a broader concept that concerns the whole company where ROIC (Return On Invested Capital) is also extracted with administrative expenses while in VIU only operating expenses are used. The total operating and administrative expenses of the company are allocated to the CGUs directly, where it is possible, and indirectly through the ratio of Net revenues (Gross Revenues - Direct expense on revenues) of each CGU to the total Net revenues (Gross Revenues - Direct expense on revenues) of the company.

5.1. Model development

In order to calculate VIU of a CGU, various valuation methods can be used. In this paper it is proposed to use the Discounted Free Cash Flow or DFCF method with an

appropriate discount rate of WACC. Specifically, free cash flows are projected for several years and the corresponding value at today's date (VIU) is calculated. The VIU is then compared to the sum of the carrying amount of the CGU with the contingent goodwill created on acquisition. If this comparison is positive, then no impairment is needed otherwise the impairment would have to be up to the amount of this difference.

The impairment is given by the following formula:

Impairment = MIN (0, VIU – [Book Value + Goodwill]) (1)

EVA is the profits remaining in the company or CGU after investors, shareholders and creditors have received the expected return on their invested capital. In particular, the EVA formula is given below:

$$EVA = NOPAT - (INVESTED\ CAPITAL(IC) * WACC)\ (2)$$

Where NOPAT is the Net Operating Profit After Tax and WACC is the Weighted Average Cost of Capital, i.e., the total return required by the parties where they have invested. The IC in this case represents the capital invested for a CGU i.e., the book value plus any goodwill. The above is calculated for each CGU separately.

$IC_i = (BV\ of\ Fixed\ Assets)_i + Goodwill_i$, Where i = 1..., n CGU (3)

Equation (2) is simplified further by taking out the common factor of Invested Capital

$$EVA_i = \left(\frac{NOPAT_i}{IC_i} - WACC\right) * IC_i (4)$$

The WACC is for the whole enterprise and not just for a CGU because shareholder, investor and bank funds are sources that finance all investments in assets and are not specific to each investment. However, if they were specific for each CGU separately then the WACC would also be different.

It is known that the return on invested capital (ROIC) is written as follows:

$$ROIC_i = \frac{NOPAT_i}{IC_i} (5)$$

Considering the equations 4 and 5

$$EVA_i = \left(ROIC_i - WACC\right) * IC_i (6)$$

Since the calculation of EVA has been analyzed, the description of the method is continued, which is the main subject of this chapter. If the EVA calculation has a negative result this is a Trigger of impairment of the CGU otherwise there is no indication of impairment.

$$Trigger\ of\ Impairment = \begin{cases} Impairment, & EVA < 0 \\ NO\ Impairment, & Otherwise \end{cases}$$

Before proceeding further with the analysis, for the sake of simplicity we express EVA as a percentage of the Invested capital by dividing (6) with ICi:

$$EVA_i = \left(ROIC_i - WACC\right) (7)$$

The impairment rate is proportional to the ratio $\frac{Eva_i}{WACC}$ this is justified as follows:

$$EVA_i = ROIC_i - WACC \overset{(5)}{\longleftrightarrow} \frac{NOPAT_i}{IC_i} - WACC \ (8)$$

From the above equation it is known that WACC and NOPAT are constants. Therefore, the IC needs to change in order to change EVA from negative to greater than or equal to 0, so that won't be a Trigger of Impairment. This change in IC is the impairment. Thus, an increase in IC decreases EVA and a decrease in IC increases EVA.

So suppose that IC must change by x, i.e. IC' = IC*(1+x), so that EVA is at least 0:

$$\frac{NOPAT_i}{IC_i * (1+x)} - WACC = 0 \leftrightarrow IC_i * (1+x) = \frac{NOPAT_i}{WACC}$$

$$1 + x = \frac{NOPAT_i}{IC_i * WACC} \overset{(5)}{\longleftrightarrow} x = \frac{ROIC_i}{WACC} - 1 = \frac{ROIC_i - WACC}{WACC}$$

So from equation 7:

$$x = \frac{Eva_i}{WACC} (9)$$

Therefore, the impairment amount corresponding to each CGU is:

$$Impairment\ amount = \frac{Eva_i}{WACC} * IC_i (10)$$

In conclusion, therefore, it is more appropriate to adopt the EVA method to be able to calculate the indication and the amount of impairment as it is not based on forecasting the future and thus has very little uncertainty.

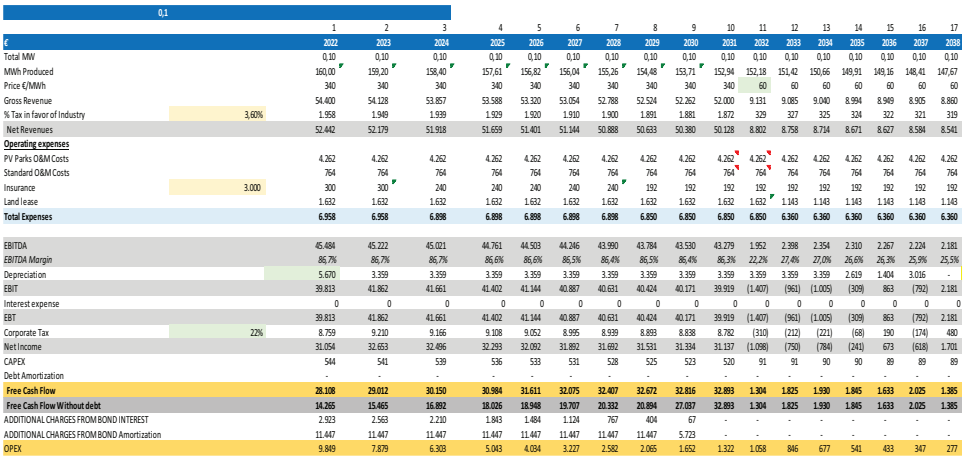
Negative EVA indicates an inability to service per CGU its financing funds. After the impairment is realized the above imbalance is corrected.

5.2. Estimations

For further explanation, a specific example follows. This example uses real data from a company that is based and conducts its business activities in Greece. This company, which will remain anonymous for confidentiality purposes, is an energy company where its portfolio includes 28 photovoltaic parks until 2021, when we have data. We treated each one as a separate CGU and applied the above methods. For each CGU we also developed a separate model. It should be stressed that this application is made

exclusively for the specific case of the company. In a different company it is appropriate to use additional data. The exact use of this methodology in another company form may lead to incorrect results.

The model is shown in Figure1: DFCFF with WACC and Figure 2: Impairment amount with VIU method



0,1																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
€		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Total MW		0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10
MWh Produced		160,00	159,20	158,40	157,61	156,82	156,04	155,26	154,48	153,71	152,94	152,18	151,42	150,66	149,91	149,16	148,41	147,67
Price €/MWh		340	340	340	340	340	340	340	340	340	340	60	60	60	60	60	60	60
Gross Revenue		54.400	54.128	53.857	53.588	53.320	53.054	52.788	52.524	52.262	52.000	9.131	9.085	9.040	8.994	8.949	8.905	8.860
% Tax in favor of Industry	3,60%	1.958	1.949	1.939	1.929	1.920	1.910	1.900	1.891	1.881	1.872	329	327	325	324	322	321	319
Net Revenues		52.442	52.179	51.918	51.659	51.401	51.144	50.888	50.633	50.380	50.128	8.802	8.758	8.714	8.671	8.627	8.584	8.541
Operating expenses																		
PV Parks O&M Costs		4.262	4.262	4.262	4.262	4.262	4.262	4.262	4.262	4.262	4.262	4.262	4.262	4.262	4.262	4.262	4.262	4.262
Standard O&M Costs		764	764	764	764	764	764	764	764	764	764	764	764	764	764	764	764	764
Insurance	3.000	300	300	240	240	240	240	240	192	192	192	192	192	192	192	192	192	192
Land lease		1.632	1.632	1.632	1.632	1.632	1.632	1.632	1.632	1.632	1.632	1.632	1.143	1.143	1.143	1.143	1.143	1.143
Total Expenses		**6.958**	**6.958**	**6.898**	**6.898**	**6.898**	**6.898**	**6.898**	**6.850**	**6.850**	**6.850**	**6.850**	**6.360**	**6.360**	**6.360**	**6.360**	**6.360**	**6.360**
EBITDA		45.484	45.222	45.021	44.761	44.503	44.246	43.990	43.784	43.530	43.279	1.952	2.398	2.354	2.310	2.267	2.224	2.181
EBITDA Margin		*86,7%*	*86,7%*	*86,7%*	*86,6%*	*86,6%*	*86,5%*	*86,4%*	*86,5%*	*86,4%*	*86,3%*	*22,2%*	*27,4%*	*27,0%*	*26,6%*	*26,3%*	*25,9%*	*25,5%*
Depreciation		5.670	3.359	3.359	3.359	3.359	3.359	3.359	3.359	3.359	3.359	3.359	3.359	3.359	2.619	1.404	3.016	-
EBIT		39.813	41.862	41.661	41.402	41.144	40.887	40.631	40.424	40.171	39.919	(1.407)	(961)	(1.005)	(309)	863	(792)	2.181
Interest expense		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EBT		39.813	41.862	41.661	41.402	41.144	40.887	40.631	40.424	40.171	39.919	(1.407)	(961)	(1.005)	(309)	863	(792)	2.181
Corporate Tax	22%	8.759	9.210	9.166	9.108	9.052	8.995	8.939	8.893	8.838	8.782	(310)	(212)	(221)	(68)	190	(174)	480
Net Income		31.054	32.653	32.496	32.293	32.092	31.892	31.692	31.531	31.334	31.137	(1.098)	(750)	(784)	(241)	673	(618)	1.701
CAPEX		544	541	539	536	533	531	528	525	523	520	91	91	90	90	89	89	89
Debt Amortization		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Free Cash Flow		**28.108**	**29.012**	**30.150**	**30.984**	**31.611**	**32.075**	**32.407**	**32.672**	**32.816**	**32.893**	**1.304**	**1.825**	**1.930**	**1.845**	**1.633**	**2.025**	**1.385**
Free Cash Flow Without debt		**14.265**	**15.465**	**16.892**	**18.026**	**18.948**	**19.707**	**20.332**	**20.894**	**27.037**	**32.893**	**1.304**	**1.825**	**1.930**	**1.845**	**1.633**	**2.025**	**1.385**
ADDITIONAL CHARGES FROM BOND INTEREST		2.923	2.563	2.210	1.843	1.484	1.124	767	404	67	-	-	-	-	-	-	-	-
ADDITIONAL CHARGES FROM BOND Amortization		11.447	11.447	11.447	11.447	11.447	11.447	11.447	11.447	5.723	-	-	-	-	-	-	-	-
OPEX		9.849	7.879	6.303	5.043	4.094	3.227	2.582	2.065	1.652	1.322	1.058	846	677	541	433	347	277

Figure 1: DFCF with WACC.

Authors calculations

	Book Value		Depreciated		Unamortised
CGU	€ 168,026.84	€	68,994.55	€	99,032.29
GoodWill				€	155,253.13
Invested Capital for CGU (GW+Unamort.)				**€**	**254,285.42**
DCF with WACC				€	228,354.83
MIN(0, DCF-IC)				**€**	**(25,930.59)**
Impairment amount	**€ (25,930.59)**				

Authors calculations

Figure 2: Impairment amount with VIU method.

Authors calculations

Developing corresponding models for all CGUs and using other financial data from the financial statements such as : administrative expenses, other expenses not included in the above model, financial cost of borrowing, amount of bond borrowing the company has and amount of equity. By placing a cost of equity equal to 10% and making indirect cost allocations to CGUs based on the ratio of each CGU's turnover to the company's total turnover, we calculate the EVA per CGU. The relevant data is provided in the Figure 3: Trigger of Impairment with EVA method.

Authors calculations

From the above table we observe that the total EVA of the firm is positive, but when it is broken down into individual CGUs some of them show negative EVA and therefore for the aggregated CGUs there exists trigger of impairment. For the amount of impairment,

WACC	6.4%												
Name	Unamortised	GoodWill	Book Value of each CGU	Earnings 2022	Debt	Debt Amortisation	Interest	Percentage of CGU's Earnings to Total Earnings	ADM	Capital	NOPAT	ROIC	EVA
CGU1	€ 1,656,711.73	€ 1,178,558.32	**€ 2,835,270.05**	799,040.56 €	€ 1,482,501.10	€ 174,411.89	€ 44,534.50	26.74%	€ (256,079.66)	€ 1,556,243.98	€ 267,807.65	9.45%	3.00%
CGU2	€ 167,067.32	€ 0.00	**€ 167,067.32**	47,777.00 €	€ 88,643.12	€ 10,428.60	€ 2,662.85	1.60%	€ (15,311.76)	€ 93,052.43	€ 12,965.07	7.76%	1.31%
CGU3	€ 331,751.00	€ 0.00	**€ 331,751.00**	105,056.09 €	€ 194,915.98	€ 22,931.29	€ 5,855.30	3.52%	€ (33,668.79)	€ 204,611.53	€ 24,241.66	7.31%	0.86%
CGU4	€ 102,667.80	€ 0.00	**€ 102,667.80**	49,832.87 €	€ 92,457.49	€ 10,877.35	€ 2,777.43	1.67%	€ (15,970.63)	€ 97,056.53	€ 16,074.63	15.66%	9.21%
CGU5	€ 569,678.68	€ 0.00	**€ 569,678.68**	176,144.78 €	€ 326,810.48	€ 38,448.29	€ 9,817.42	5.89%	€ (56,451.57)	€ 343,066.76	€ 40,321.75	7.08%	0.63%
CGU6	€ 2,577,192.80	€ 0.00	**€ 2,577,192.80**	712,622.35 €	€ 1,322,164.94	€ 155,548.82	€ 39,717.99	23.85%	€ (228,384.01)	€ 1,387,932.35	€ 255,245.78	9.90%	3.45%
CGU7	€ 99,032.29	€ 155,253.13	**€ 254,285.42**	52,441.60 €	€ 97,297.60	€ 11,446.78	€ 2,922.83	1.75%	€ (16,806.69)	€ 102,137.40	€ 14,943.69	5.88%	-0.57%
CGU8	€ 104,124.47	€ 70,844.51	**€ 174,968.98**	45,687.34 €	€ 84,766.07	€ 9,972.48	€ 2,546.38	1.53%	€ (14,642.06)	€ 88,982.52	€ 13,950.30	7.97%	1.52%
CGU9	€ 104,669.49	€ 77,630.40	**€ 182,299.89**	45,345.84 €	€ 84,132.47	€ 9,897.94	€ 2,527.35	1.52%	€ (14,532.61)	€ 88,317.40	€ 13,806.88	7.57%	1.12%
CGU10	€ 97,597.67	€ 84,849.44	**€ 182,447.11**	45,488.70 €	€ 84,397.53	€ 9,929.12	€ 2,535.31	1.52%	€ (14,578.40)	€ 88,595.65	€ 14,868.21	8.15%	1.70%
CGU11	€ 101,128.77	€ 51,264.16	**€ 152,392.93**	45,488.70 €	€ 84,397.53	€ 9,929.12	€ 2,535.31	1.52%	€ (14,578.40)	€ 88,595.65	€ 14,095.16	9.25%	2.80%
CGU12	€ 104,550.89	€ 195,753.38	**€ 300,304.27**	51,969.63 €	€ 96,421.92	€ 11,343.76	€ 2,896.53	1.74%	€ (16,655.43)	€ 101,218.16	€ 17,331.86	5.77%	-0.68%
CGU13	€ 100,647.25	€ 77,258.58	**€ 177,905.83**	44,494.14 €	€ 82,552.27	€ 9,712.03	€ 2,479.88	1.49%	€ (14,259.66)	€ 86,658.61	€ 13,322.30	7.49%	1.04%
CGU14	€ 105,215.31	€ 94,332.92	**€ 199,548.23**	44,821.08 €	€ 83,158.86	€ 9,783.40	€ 2,498.10	1.50%	€ (14,364.44)	€ 87,295.37	€ 13,742.09	6.89%	0.44%
CGU15	€ 105,398.00	€ 97,766.47	**€ 203,164.47**	44,782.62 €	€ 83,087.50	€ 9,775.00	€ 2,495.96	1.50%	€ (14,352.11)	€ 87,220.46	€ 13,695.97	6.74%	0.29%
CGU16	€ 107,314.61	€ 80,436.79	**€ 187,751.40**	44,381.50 €	€ 82,343.28	€ 9,687.44	€ 2,473.60	1.49%	€ (14,223.56)	€ 86,439.22	€ 13,236.60	7.05%	0.60%
CGU17	€ 119,485.19	€ 122,618.25	**€ 242,103.44**	52,648.09 €	€ 97,680.71	€ 11,491.85	€ 2,934.34	1.76%	€ (16,872.87)	€ 102,539.56	€ 15,929.78	6.58%	0.13%
CGU18	€ 119,270.46	€ 122,618.25	**€ 241,888.71**	52,480.93 €	€ 97,370.57	€ 11,455.36	€ 2,925.02	1.76%	€ (16,819.30)	€ 102,214.00	€ 16,035.56	6.63%	0.18%
CGU19	€ 135,221.80	€ 122,618.25	**€ 257,840.05**	52,975.85 €	€ 98,288.82	€ 11,563.39	€ 2,952.61	1.77%	€ (16,977.91)	€ 103,177.92	€ 14,618.44	5.67%	-0.78%
CGU20	€ 69,823.65	€ 38,285.13	**€ 108,108.78**	53,991.90 €	€ 100,173.96	€ 11,785.17	€ 3,009.24	1.81%	€ (17,303.54)	€ 105,156.84	€ 20,876.67	19.31%	12.86%
CGU21	€ 67,983.60	€ 38,285.13	**€ 106,268.73**	54,558.93 €	€ 101,225.99	€ 11,908.94	€ 3,040.84	1.83%	€ (17,485.26)	€ 106,261.20	€ 21,473.83	20.21%	13.76%
CGU22	€ 108,480.94	€ 46,267.22	**€ 154,748.16**	53,588.76 €	€ 99,425.99	€ 11,697.17	€ 2,986.77	1.79%	€ (17,174.34)	€ 104,371.65	€ 19,028.16	12.30%	5.85%
CGU23	€ 114,439.67	€ 73,380.13	**€ 187,819.80**	52,946.35 €	€ 98,234.09	€ 11,556.95	€ 2,950.96	1.77%	€ (16,968.45)	€ 103,120.47	€ 16,653.74	8.87%	2.42%
CGU24	€ 108,250.15	€ 73,380.13	**€ 181,630.28**	52,946.35 €	€ 98,234.09	€ 11,556.95	€ 2,950.96	1.77%	€ (16,968.45)	€ 103,120.47	€ 17,140.24	9.44%	2.99%
CGU25	€ 116,457.22	€ 93,184.67	**€ 209,641.89**	52,313.77 €	€ 97,060.44	€ 11,418.88	€ 2,915.71	1.75%	€ (16,765.72)	€ 101,888.44	€ 16,327.81	7.79%	1.34%
CGU26	€ 111,174.55	€ 93,184.67	**€ 204,359.22**	51,527.15 €	€ 95,600.97	€ 11,247.17	€ 2,871.86	1.72%	€ (16,513.62)	€ 100,356.38	€ 16,251.41	7.95%	1.50%
CGU27	€ 107,721.80	€ 167,647.33	**€ 275,369.13**	51,332.79 €	€ 95,240.36	€ 11,204.75	€ 2,861.03	1.72%	€ (16,451.33)	€ 99,977.83	€ 16,752.66	6.08%	-0.37%
CGU28	€ 102,626.50	€ 167,647.33	**€ 270,273.83**	51,723.81 €	€ 95,965.84	€ 11,290.10	€ 2,882.82	1.73%	€ (16,576.65)	€ 100,739.39	€ 17,493.59	6.47%	0.02%
	€ 7,715,683.61	€ 3,323,064.57	**€ 11,038,748.18**	**€ 2,988,409.48**	€ 5,544,550.00	€ 652,300.00	€ 166,558.92	100.00%	€ (957,737.23)	€ 5,820,348.18	€ 968,231.48	8.77%	2.32%

Authors calculations

Figure 3: Trigger of Impairment with EVA method.

we apply the methodology developed above based on EVA ($\frac{Eva_i}{WACC} * IC_i$) and the methodology based on DFCF from Table1.

WACC	6.4%						
Name	EVA	TRIGER	Negative EVA	EVA/WACC	IMPAIRMENT= IC*EVA/WACC	DCF with WACC	IMPAIRMENT FCF WITH WACC
CGU1	3.00%	0.00%	0.00%	0.0%	€ 0.00	€ 3,534,584.25	€ -
CGU2	1.31%	0.00%	0.00%	0.0%	€ 0.00	€ 239,594.88	€ -
CGU3	0.86%	0.00%	0.00%	0.0%	€ 0.00	€ 509,710.95	€ -
CGU4	9.21%	0.00%	0.00%	0.0%	€ 0.00	€ 251,577.85	€ -
CGU5	0.63%	0.00%	0.00%	0.0%	€ 0.00	€ 851,877.17	€ -
CGU6	3.45%	0.00%	0.00%	0.0%	€ 0.00	€ 3,469,643.99	€ -
CGU7	-0.57%	TRIGGER	-0.57%	-8.9%	-€ 22,584.50	€ 228,354.83	€ (25,930.59)
CGU8	1.52%	0.00%	0.00%	0.0%	€ 0.00	€ 218,651.67	€ -
CGU9	1.12%	0.00%	0.00%	0.0%	€ 0.00	€ 215,579.21	€ -
CGU10	1.70%	0.00%	0.00%	0.0%	€ 0.00	€ 217,324.02	€ -
CGU11	2.80%	0.00%	0.00%	0.0%	€ 0.00	€ 217,558.85	€ -
CGU12	-0.68%	TRIGGER	-0.68%	-10.5%	-€ 31,575.00	€ 244,162.46	€ (56,141.81)
CGU13	1.04%	0.00%	0.00%	0.0%	€ 0.00	€ 212,037.96	€ -
CGU14	0.44%	0.00%	0.00%	0.0%	€ 0.00	€ 219,753.55	€ -
CGU15	0.29%	0.00%	0.00%	0.0%	€ 0.00	€ 219,460.26	€ -
CGU16	0.60%	0.00%	0.00%	0.0%	€ 0.00	€ 226,717.49	€ -
CGU17	0.13%	0.00%	0.00%	0.0%	€ 0.00	€ 241,957.85	€ (145.59)
CGU18	0.18%	0.00%	0.00%	0.0%	€ 0.00	€ 241,849.42	€ (39.29)
CGU19	-0.78%	TRIGGER	-0.78%	-12.1%	-€ 31,182.11	€ 237,299.11	€ (20,540.94)
CGU20	12.86%	0.00%	0.00%	0.0%	€ 0.00	€ 249,484.30	€ -
CGU21	13.76%	0.00%	0.00%	0.0%	€ 0.00	€ 253,239.91	€ -
CGU22	5.85%	0.00%	0.00%	0.0%	€ 0.00	€ 253,872.86	€ -
CGU23	2.42%	0.00%	0.00%	0.0%	€ 0.00	€ 244,487.85	€ -
CGU24	2.99%	0.00%	0.00%	0.0%	€ 0.00	€ 245,291.20	€ -
CGU25	1.34%	0.00%	0.00%	0.0%	€ 0.00	€ 248,459.98	€ -
CGU26	1.50%	0.00%	0.00%	0.0%	€ 0.00	€ 242,109.27	€ -
CGU27	-0.37%	TRIGGER	-0.37%	-5.7%	-€ 15,620.23	€ 239,075.77	€ (36,293.36)
CGU28	0.02%	0.00%	0.00%	0.0%	€ 0.00	€ 243,392.26	€ (26,881.57)
	2.32%				€ (100,961.84)	€ 14,017,109.16	€ (165,973.16)

Authors calculations

Figure 4: Impairment amount with EVA and VIU method.

Authors calculations

From the Figure4 we can see that the two methodologies extract roughly the same results with minor differences but the EVA-based methodology, as mentioned above, is more general, aggregated and directly applicable covering both the Trigger of Impairment and the amount of Impairment.

We then develop a model for whole business valuation which can be applied to the requirements of IFRS 9 when there is an equity interest in a company.

6. The Model for Entity's Valuation and Estimations

Suppose first that a subsidiary wholly owned by a parent is equivalent to a CGU. The book value of the CGU is 3,000,000 euros including goodwill. The industry to which the CGU belongs has a high level of growth (7% -15%). In the long run, an annual growth rate of the business sector by 1% is expected. Management has no plans to expand the CGU's capacity and believes that a reorganization can achieve cost savings but has not yet committed to a plan yet, also assumes that a number of key indexes are achievable in a min, max and most likely, range.

Management wants to determine the recoverable amount of the CGU on December 31, 2019 based on a VIU approach. The discount rate is calculated at 12.5%.

6.1. The static model

The hypotheses and the model are provided in the following tables. Initially, the assumptions based on which the company constructs a five-year business plan - budget are provided. The assumptions are applied to the historical and current internal data of the business plan's base year. In our application we provide the capable and necessary indicators in order to be able to produce for the business plan the accounting budget profits of the company, the investments in capital assets, the working capital and its changes and finally the operating cash flows before and after taxes. The indicators on which the assumptions are based must be reasonable, observable, and provided with a range of values on them with min max and most likely values. This range of indicators will help us to introduce the uncertainty and risk on the company's cash flow. Figure 5 provides these data:

Authors calculations

Authors calculations

The VIU is found in the manner described in the Figure 7 below:

ASSUMPTIONS	BASE	min	Most likely	max
Increase of Sales	Sales-1	7%	10%	15%
Margin of cost of sales	Sales	40%	50%	60%
Expenses	Sales	25%	30%	35%
Income tax	EBIT	24%	24%	24%
Days on receivables (services)	Sales	70	90	120
Days on suppliers (services)	Sales	90	100	120
Other Current Assets	Sales	1,5%	2,0%	3,0%
Other Current Liabilities	Sales	3,0%	4,0%	5,0%
Net Capital assets expenditures	Sales	3%	4%	5%

Authors calculations

Figure 5: Assumptions – Assumptions.

Income Statement	2019	2020	2021	2022	2023	2024
Sales	€ 2.000,0	€ 2.200,0	€ 2.420,0	€ 2.662,0	€ 2.928,2	€ 3.221,0
Cost of sales	€(1.000,0)	€(1.100,0)	€(1.210,0)	€(1.331,0)	€(1.464,1)	€(1.610,5)
Other Operating Income	-	-	-	-	-	-
Total Revenue	€ 1.000,0	€ 1.100,0	€ 1.210,0	€ 1.331,0	€ 1.464,1	€ 1.610,5
Operating Expenses	600,0	660,0	726,0	798,6	878,5	966,3
Other Expenses	50,0	65,0	84,5	109,9	142,8	185,6
Total Expenses	€ 650,0	€ 725,0	€ 810,5	€ 908,5	€ 1.021,3	€ 1.152,0
EBITDA	€ 350,0	€ 375,0	€ 399,5	€ 422,6	€ 442,8	€ 458,6
Depreciation and Amortization	(40,0)	(41,6)	(43,3)	(45,0)	(46,8)	(48,7)
EBIT	**€ 390,0**	**€ 416,6**	**€ 442,8**	**€ 467,5**	**€ 489,6**	**€ 507,2**
Cash Flow from Operations						
EBITDA	€ 350,0	€ 375,0	€ 399,5	€ 422,6	€ 442,8	€ 458,6
Less: Capex (Replacement capital expenditure)	(80,0)	(88,0)	(96,8)	(106,5)	(117,1)	(128,8)
Less: (Increase) / Decrease in WC	(20,0)	(22,2)	(24,4)	(26,9)	(29,6)	(32,5)
Unlevered Pre-Tax CFO	€ 250,0	€ 264,8	€ 278,3	€ 289,2	€ 296,1	€ 297,2

Authors calculations

Figure 6: Estimates based on assumptions for the elements of a five-year business plan.

Unlevered Pre-Tax CFO	€ 250,0	€ 264,8	€ 278,3	€ 289,2	€ 296,1
Discount rate (pre-tax rate based on WACC)	12,50%				
Discount period		1	2	3	4
Discount factor		0,888889	0,790123457	0,702332	0,6242951
Present value of free cash flow		235,358	219,8562414	203,10114	184,87202
Present value of free cash flow (FY20 to FY24)	1.008,10				
future growth	1%				
Present value of terminal value*	1.448,38				
Value in use	€ 2.456,5				

Authors calculations

Figure 7: Calculation of the VIU.

Authors calculations

EBITDA can be used as a surrogate in the projection of cash flow related to income and expenses.

However, adjustments need to be made to take account of other cash flows not recorded in EBITDA, including working capital movements and capital expenditures. As required by IAS 36, cash flow forecasts for periods beyond the most recent budgets / forecasts are extrapolated using a fixed or declining growth rate, unless an increasing growth rate is justified. The resulting result is called a terminal value. It is then discounted to the present value. To calculate the present terminal value in this example, we calculated the normalized future long-term cash flow determined using the 2024 pre-tax cash flow of 297.2 (according to the table above), thus 1,448.38 = (297.2 * 1.01) / (12.5% -1%) * 0.5549.

Based on the VIU set out above, the CGU has an impairment loss of € 543.5 (= 3,000 - 2,456.5) as the VIU is lower than the book value for the CGU, management should calculate the FVLCS, the highest of the two will be the recoverable amount of the CGU.

How measuring risk and uncertainty? Both FVLCS and VIU have to reflect risk and uncertainty which is difficult. The risk may be reflected in either the cash flow adjustment or the discount rate, but not both. Determining an appropriate discount rate that reflects current market assessments and appropriate risks (but not the risks already contained in cash flows).

Especially, for convertible preferred stock the DDM valuation is the appropriate one and we examine a case study with stable dividends for 9 years and after conversion a constant increase rate of g.

In our approach we assume a stable dividend on the amount of 0.319 EUR for each preferred stock. Initially, at time 0(2019) dividends are not discounted. Then, we add the dividends corresponding the stable 9 years period, discounted by the necessary interest rate. Finally, for the period after the nine years, we assume that common shares enjoy the returns of the preferred shares but with a relative annual percentage increase (Growth Rate), where we used the average of the Sustainable Growth Rate (SGR), Internal Growth Rate (IGR) and Economic Growth Rate (EGR):

$$SGR:\ ROE_0 * \beta\ IGR:\ \frac{ROA_0 * \beta}{(1 - ROA_0 * \beta)} EGR:\ \frac{Revenue_0}{Revenue_0} - 1$$

ROE : Return on Equity

ROA: Return on Assets

β: (1 – dividend payout ratio)

Finally, we use Gordon & Shapiro's dividend yield method to find the valuation of the stock after the 9th year. Therefore, it should be also discounted with the appropriate multiplier to reach the actual net present value:

$$NPV_{div}=div_0+div*\frac{(1+k_e)^n-1}{k_e*(1+k_e)^n}+div*\frac{(1+g)}{(k_e-g)*(1+k_e)^n}(11)$$

k_e: Discounted interest rate (average of company's WACC and Total Equity Risk Premium)

Div: Divident (0,319)

n: Discounted Years (9)

g: $\frac{SGR+IGR+EGR}{3}$

Detailed Calculations are presented in Figure 8:

Data	
Divident	0.319
Years	2019-2028
Perpetual	2028 to perpetual
Cost of Capital	7.0%
Growth Rate	3.35%

Cost of Capital	
COC per Country	
Greece	7.9%
Average	7.9%
COC IVSC	
Discount rate for solar	6.0%
Average	6.0%
Average COC	7.0%

Growth Rates	
Sustainable Growth Rate	
	2019
SGR (1)	6.2%
Internal Growth Rate	
IGR(2)	1.70%
Economic Growth Rate	
EGR(3)	2.10%
(1)(2)(3)	3.3%

Authors calculation

Figure 8: Detailed Calculations for Growth Rate and Cost Of Capital.

Authors calculation

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2028-Perpetual
Dividents	0.319	0.319	0.319	0.319	0.319	0.319	0.319	0.319	0.319	0.319	0.319
Discounted Rate (7%)	-	0.9350	0.8743	0.8174	0.7643	0.7147	0.6682	0.6248	0.5842	0.5462	15.6752
PV div	0.319	0.298	0.279	0.261	0.244	0.228	0.213	0.199	0.186	0.174	5.000
NPV	7										

Authors calculations

Figure 9: Stock Valuation.

Authors calculations

As per the above calculations we derive that common stock is valued to 7 EUR.

According to above calculations we estimate a method in order companies to be able to value common & preferred stock. As per the above, actual price is calculated through certain assumptions and actual data from companies' financial statements.

6.2. Investigation of uncertainty and risk

In our article we investigate the uncertainty by assuming that the variables of our assumptions follow the PERT or UNIFORM distribution and by simulating the “value in use” VIU with 50,000 iterations with the Monte Carlo method.

The reason for using PERT or UNIFORM distributions is that they are easily determined using only the min, max, and most likely, values. Without this being a limitation of our article, we declare that the use of distributions with historical data and with determination after estimation of mean and variance would be a better approach, with appropriate distribution Normal. In an extension of our research this will be sought.

We estimated the changes in fair value (VIU) first for the assumptions that affect the Cash Flow cash flows of the company to be valued (CGU) when they follow a PERT distribution, the results are given in the figures below.

Name	Cell	Graph	Function	Min	Mean	Max
Increase of Sales	D40	35% 65%	RiskPert(0,07;0,1;0,15;RiskStatic(0,1);RiskName(A40))	7%	10%	15%
Margin of cost of sales	D41	24% 36%	RiskPert(0,4;0,5;0,6;RiskStatic(0,5);RiskName(A41))	40%	50%	60%
Expenses	D42	60 130	RiskPert(0,25;0,3;0,35;RiskStatic(0,3);RiskName(A42))	25%	30%	35%
Days on receivables	D44	85 125	RiskPert(70;90;120;RiskStatic(90);RiskName(A44))	70	92	120
Days on suppliers	D45	1,4% 3,2%	RiskPert(90;100;120;RiskStatic(100);RiskName(A45))	90	102	120
Other Current Assets	D46	2,5% 5,5%	RiskPert(0,015;0,02;0,03;RiskStatic(0,02);RiskName(A46))	1,5%	2,1%	3,0%
Other Current Liabilities	D47	2,5% 5,5%	RiskPert(0,03;0,04;0,05;RiskStatic(0,04);RiskName(A47))	3,0%	4,0%	5,0%
Net Capital assets expenditures	D48		RiskPert(0,03;0,04;0,05;RiskStatic(0,04);RiskName(A48))	3%	4%	5%

Authors calculations

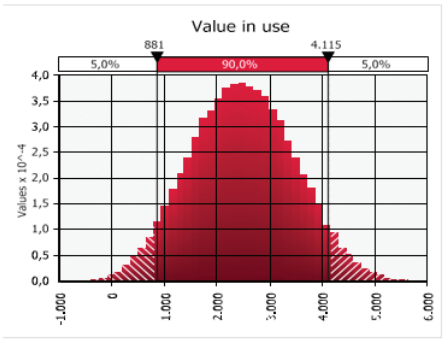
Figure 10: Input Variables for Cash Flow.

Authors calculations

Authors calculations

Then we used only the discount factor and future long-term growth as input variables. We tested two distributions, PERT and UNIFORM; the results are provided in the figures.

Authors calculations



Simulation Summary Information	
Workbook Name	model v.3.xlsx
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Number of Iterations	50000
Number of Inputs	8
Number of Outputs	1
Sampling Type	Latin Hypercube
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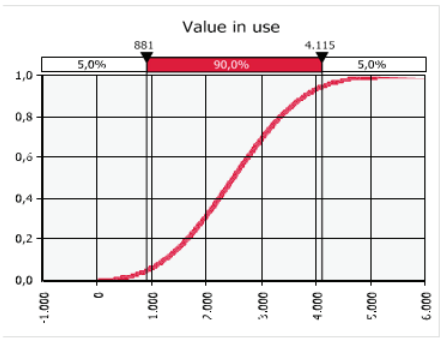
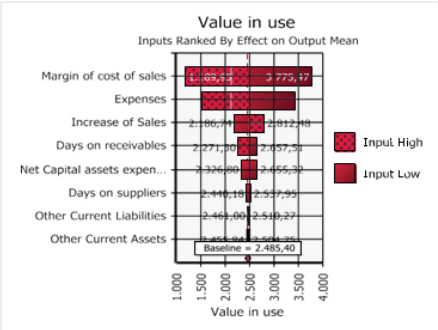
Random Seed	54283997
Total Errors	0
Collect Distribution Samples	All
Convergence Testing	Disabled
Smart Sensitivity Analysis	Enabled



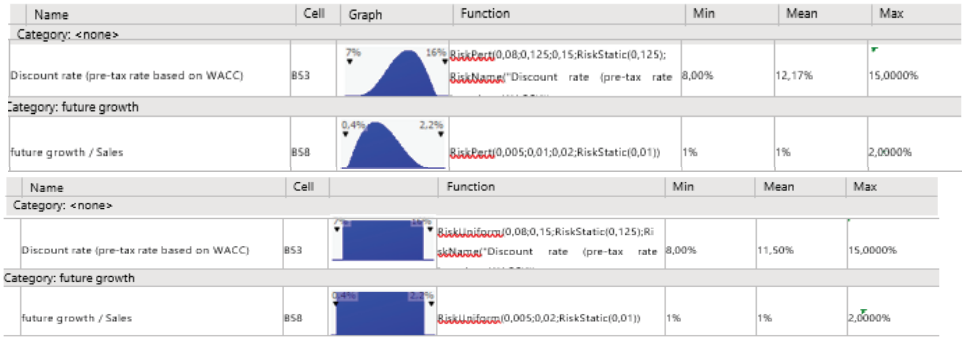
Summary Statistics for Value in use			
Statistics		Percentile	
Minimum	€(829,4)	1,0%	€ 341,2
Maximum	€ 5.921,6	2,5%	€ 616,5
Mean	€ 2.485,4	5,0%	€ 880,8
Std Dev	€ 981,9	10,0%	€ 1.204,7
Variance	964151,2038	20,0%	€ 1.624,7
Skewness	0,053535348	25,0%	€ 1.788,1
Kurtosis	2,686095591	50,0%	€ 2.477,3
Median	€ 2.477,3	75,0%	€ 3.167,0
Mode	€ 2.229,5	80,0%	€ 3.336,3
Left X	€ 880,8	90,0%	€ 3.773,3
Left P	5%	95,0%	€ 4.115,1
Right X	€ 4.115,1	97,5%	€ 4.405,1
Right P	95%	99,0%	€ 4.728,5
#Errors	0		



Change in Output Statistic for Value in use			
Rank	Name	Lower	Upper
1	Margin of cost of	€ 1.190,0	€ 3.775,5
2	Expenses	€ 1.524,4	€ 3.432,9
3	Increase of Sales	€ 2.186,7	€ 2.812,5
4	Days on receivab	€ 2.271,3	€ 2.657,5
5	Net Capital asse	€ 2.326,8	€ 2.655,3
6	Days on supplier	€ 2.440,2	€ 2.537,9
7	Other Current Li	€ 2.461,0	€ 2.510,3
8	Other Current As	€ 2.455,8	€ 2.504,8

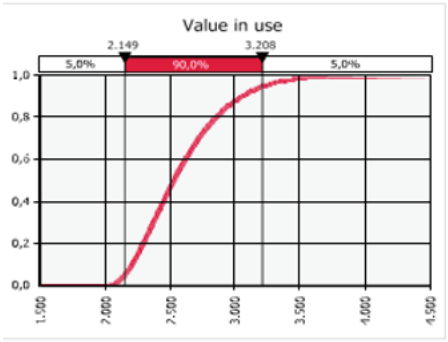
Authors calculations

Figure 11: VIU Sensitivity Analysis.

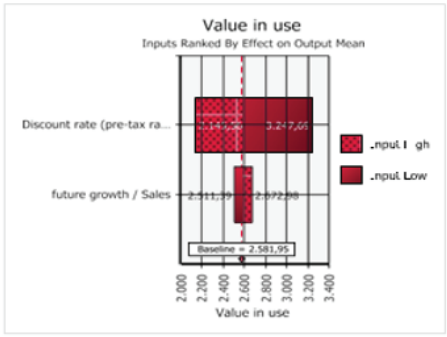


Authors calculations

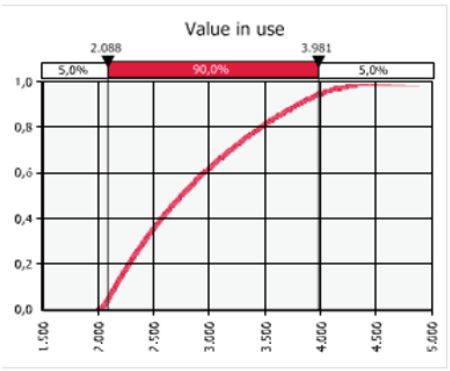
Figure 12: Input Variables for Discount Factors.



Summary Statistics for Value in use			
Statistics		Percentile	
Minimum	€ 1.988,1	1,0%	€ 2.075,1
Maximum	€ 4.117,3	2,5%	€ 2.110,8
Mean	€ 2.581,9	5,0%	€ 2.148,8
Std Dev	€ 328,2	10,0%	€ 2.203,8
Variance	107742,8154	20,0%	€ 2.292,1
Skewness	0,811011468	25,0%	€ 2.330,0
Kurtosis	3,407748468	50,0%	€ 2.525,7
Median	€ 2.525,7	75,0%	€ 2.777,8
Mode	€ 2.302,7	80,0%	€ 2.847,9
Left X	€ 2.148,8	90,0%	€ 3.043,5
Left P	5%	95,0%	€ 3.208,1
Right X	€ 3.208,1	97,5%	€ 3.350,5
Right P	95%	99,0%	€ 3.514,7
#Errors	0		



Change in Output Statistic for Value in use			
Rank	Name	Lower	Upper
1	Discount rate (pr	€ 2.145,6	€ 3.247,7
2	future growth / S	€ 2.511,4	€ 2.673,0



Summary Statistics for Value in use			
Statistics		Percentile	
Minimum	€ 1.973,6	1,0%	€ 2.022,2
Maximum	€ 4.562,1	2,5%	€ 2.052,7
Mean	€ 2.857,3	5,0%	€ 2.087,9
Std Dev	€ 607,4	10,0%	€ 2.145,2
Variance	368970,2923	20,0%	€ 2.268,2
Skewness	0,566963626	25,0%	€ 2.336,9
Kurtosis	2,308855116	50,0%	€ 2.737,6
Median	€ 2.737,6	75,0%	€ 3.304,4
Mode	€ 2.128,1	80,0%	€ 3.444,4
Left X	€ 2.087,9	90,0%	€ 3.772,5
Left P	5%	95,0%	€ 3.981,1
Right X	€ 3.981,1	97,5%	€ 4.138,1
Right P	95%	99,0%	€ 4.286,1
#Errors	0		

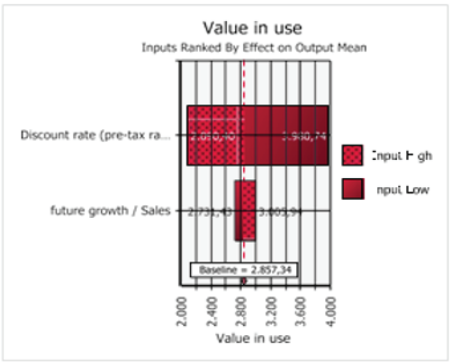
Authors calculations

Finally, although it is not recommended by the proposals of the accounting standards, we estimate the VIU when changes occur in all input variables, both for those that affect the cash flow and for changes in the Discount Factors. Estimates are provided in the tables below.

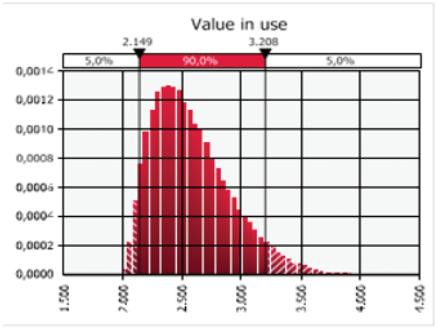
Authors calculations

Authors calculations

Reviewing the above estimates for the VIU we observe that this is influenced by the input variables that affect Cash Flow, mainly through the variables, in order, first the percentage of cost of Sales sold, second, the percentage of expenses in sales and third, the increase of sales. On the other hand, VIU is observed to be affected by the input variables that affect the Discount Factors mainly through the Discount Rate variable. The format of the distributions functions affects the mean value of the VIU. It does not differ



Change in Output Statistic for Value in use			
Rank	Name	Lower	Upper
1	Discount rate (pr	€ 2.090,4	€ 3.980,7
2	future growth / S	€ 2.731,4	€ 3.005,9



Simulation Summary Information	
Workbook Name	model v.2.xlsx
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Number of Iterations	50000
Number of Inputs	2
Number of Outputs	1
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Simulation Start Time	20/9/2020 9:53
Simulation Stop Time	20/9/2020 9:54
Simulation Duration	00:01:07
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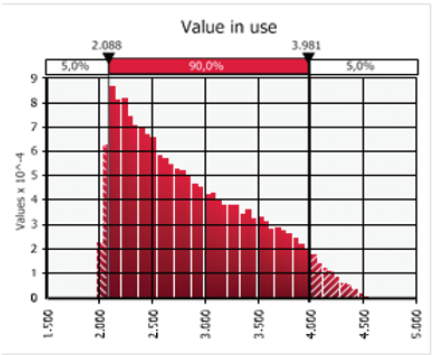
Random Seed	1410506456
Total Errors	0
Collect Distribution Samples	All
Convergence Testing	Disabled
Smart Sensitivity Analysis	Enabled



Simulation Summary Information	
Workbook Name	model v.5.xlsx
Number of Simulations	1
Number of Iterations	50000
Number of Inputs	2
Number of Outputs	1
Sampling Type	Latin Hypercube
Simulation Start Time	21/9/2020 10:06
Simulation Stop Time	21/9/2020 10:07
Simulation Duration	00:01:06
Random # Generator	Mersenne Twister
Random Seed	568001553
Total Errors	0
Collect Distribution Samples	All
Convergence Testing	Disabled
Smart Sensitivity Analysis	Enabled

Authors calculations

Figure 13: VIU Volatility Assessment when Discount Factors are Affected.

significantly from the static model when the input variables affecting Cash Flow follow PERT or UNIFORM distribution functions and the input variables affecting Discount Factors follow PERT. The mean value of the VIU changes significantly, approaching the acquisition cost of the subsidiary, when the Discount Rate follows UNIFORM distribution function, (ie each Discount Rate has the same probability of occurring).

Summarizing all evidence, we provide below a combined Figure 16 for our estimations.

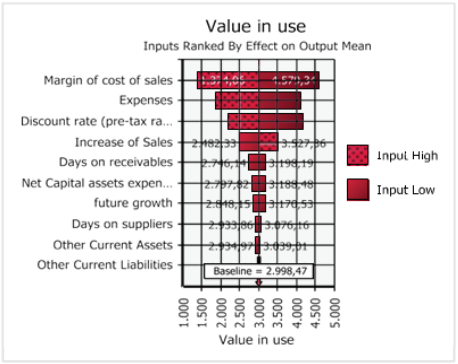
Authors calculations

Looking in Figure 16 we observe that current amount is within all intervals confidence for each significant percentage and due to that it is possible someone deduce that

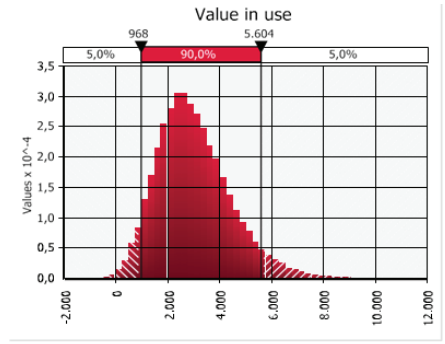
Name	Cell	Graph	Function	Min	Mean	Max
Discount rate (pre-tax rate based on WACC)	B53		RiskUniform(0,08;0,15;RiskStatic(0,125);RiskName("Discount rate (pre-tax rate	8,00%	11,50%	15,00%
future growth	B58		RiskUniform(0,005;0,02;RiskStatic(0,01);RiskName("future growth "))	1%	1%	2%
Increase of Sales	D40		RiskUniform(0,07;0,15;RiskStatic(0,1);RiskName(A40))	7%	11%	15%
Margin of cost of sales	D41		RiskPert(0,4;0,5;0,6;RiskStatic(0,5);RiskName(A41))	40%	50%	60%
Expenses	D42		RiskPert(0,25;0,3;0,35;RiskStatic(0,3);RiskName(A42))	25%	30%	35%
Days on receivables	D44		RiskPert(70;90;120;RiskStatic(90);RiskName(A44))	70	92	120
Days on suppliers	D45		RiskPert(90;100;120;RiskStatic(100);RiskName(A45))	90	102	120
Other Current Assets	D46		RiskPert(0,015;0,02;0,03;RiskStatic(0,02);RiskName(A46))	1,5%	2,1%	3,0%
Other Current Liabilities	D47		RiskPert(0,03;0,04;0,05;RiskStatic(0,04);RiskName(A47))	3,0%	4,0%	5,0%
Net Capital assets expenditures	D48		RiskPert(0,03;0,04;0,05;RiskStatic(0,04);RiskName(A48))	3%	4%	5%

Authors calculations

Figure 14: Input Variables for Cash Flow and Discount Factors.



Change in Output Statistic for Value in use			
Rank	Name	Lower	Upper
1	Margin of cost of	€ 1.374,1	€ 4.579,3
2	Expenses	€ 1.846,7	€ 4.126,0
3	Discount rate (pr	€ 2.173,0	€ 4.173,9
4	Increase of Sales	€ 2.482,3	€ 3.527,4
5	Days on receivab	€ 2.746,1	€ 3.198,2
6	Net Capital asse	€ 2.797,8	€ 3.188,5
7	future growth	€ 2.848,2	€ 3.170,5
8	Days on supplier	€ 2.933,9	€ 3.076,2
9	Other Current As	€ 2.935,0	€ 3.039,0
10	Other Current Li	€ 2.964,2	€ 3.037,6



Workbook Name	model v.7.xlsx
Number of Simulations	1
Number of Iterations	50000
Number of Inputs	10
Number of Outputs	1
Sampling Type	Latin Hypercube
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Simulation Stop Time	21/9/2020 9:57
Simulation Duration	00:01:07
Random # Generator	Mersenne Twister
Random Seed	254424645
Total Errors	0
Collect Distribution Samples	All
Convergence Testing	Disabled
Smart Sensitivity Analysis	Enabled

Authors calculations

Figure 15: VIU Volatility Assessment when Cash Flow and Discount Factors are affected.

the process of impairment testing is not necessary recording in the account book of company.

In thousand Euros	Confidence Intervals								
Probability	95%		75%		50%				
Limits	min	max	min	max	min	max	Mean	Std De	CV
VIU with cash flow factors movements	880,8035	5921,579	1204,668	3531,892	1788,119	3167,007	2485,405	981,912	39,51%
VIU with discount factors movements	2052,677	4138,086	2087,912	3444,438	2336,884	3304,442	2857,344	607,4292	21,26%
VIU with all factors movements	665,6343	6268,595	967,7795	4104,415	1992,303	3832,445	2998,474	1421,429	47,41%

Current Amount	3.000,00

For 95% min=2,5%PERC and max=97,5%PERC
For 50% min=25%PERC and max=75%PERC
For to 75% min=10%PERC max=85%PERC
Authors calculations

Figure 16: VIU Confidence intervals.

7. CONCLUSION

In relation to the impairment models developed, the main conclusion is that EVA is a complete and consistent methodology for both the Trigger of Impairment and the amount of impairment.

In relation to the model, we developed for valuing an entity, as if it were a CGU under IFRS 9 and IAS 36 under certainty and uncertainty, are as follows:

1. First,
   (a) an unlisted company is equivalent to a CGU cash-generating
   (b) several times the input data is level 3,
   (c) the valuation or fair value measuring is done with the “value in use” VIU method and
   (d) finally, when the income approach is used to find the fair value, then a competent and necessary business plan must be created.
2. The assumptions - external variable inputs of this model must be observable and feasible from the market to be more closed to inputs level 2.
3. The internal variables must come both from the accounting financial statements for the base period - the start of the business plan and from prices or indicators of the industry-sector in which the company operates.
4. Uncertainty and risk can appear in the financial statements of the parent company by disclosing the input variables for valuation with their price ranges and the distribution functions that follows.
5. It should be a matter of academic debate when the value of an unlisted company is impaired because, as we presented in our article, there is a significant probability that the current value does not impaired.

6. As it appeared in our article, depending on the assumptions for the distributions functions that follow the input variables and especially the Discount Rate, the average VIU may differ from the static one.
7. The range of input variables has also significant importance and the narrower and more focused ranges, produce more accurate results.
8. Looking in table10 we observe that current amount is within all interval's confidence for each significant percentage and due to that it is possible someone deduce that the process of impairment testing is not necessary recording in the account book of company.

Future research will be to develop models that jointly rely on the well-established methods of EVA which is an ex-post methodology and DCF which is an ex-ante methodology where projections are based on historical data.

When Trigger of Impairment occurs then parallel calculation's procedure for the specific amount of Impairment is necessary. The implied methodologies in our article should satisfy ex-post and ex-ante analysis. The EVA ex-post and DFCF ex-ante methodology in a global Model creates a consistent, compatible, and adequate procedure which be implemented to fulfill the accounting provisions of IAS 36 and IFRS 9.

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