

The Evaluation of Intangibles: Advocating for an Option Based Approach

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Abstract

This paper provides a full and comprehensive picture of the methods and measures applied to the evaluation of Intangibles. It suggests an expanded frame for Intangibles' evaluation including Intangible Assets and Intellectual Capital. It also proposes a coherent framework for evaluation and discusses well-accepted and emerging contributions. Beyond "Global" and "Asset by Asset" approaches it advocates for a third way represented by options , thus opening to an enlarged evaluating model.

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The evaluation of Intangibles: Advocating for an Option Based Approach

This paper, based on previous works (see Bouteiller, 2000; Bouteiller and Ruiz, 2001) provides a full and comprehensive picture of the methods and measures applied to the evaluation of Intangibles. It suggests an expanded frame for Intangibles' evaluation including Intangible Assets and Intellectual Capital. It also proposes a coherent framework for evaluation and discusses well-accepted and emerging contributions. Beyond "Global" and "Asset by Asset" approaches it advocates for a third way represented by options , thus opening to an enlarged evaluating model.

The evaluation of Intangibles starts in a first section with their identification through the concepts of Intangible Assets and Intellectual Capital. We discuss their robustness and give a compact definition for each of them. Section II presents an evaluation framework for Intangibles. It categorizes current split contributions into two coherent sets: "Global" and "Asset by Asset" approaches. Section III discusses "Global" approaches. It reviews traditional methods, then emphasizes the interest of recent contribution such as the "Total Value Creation Approach," the "Average Normalized Earnings and the Knowledge Capital." Section IV investigates "Asset by Asset" approaches. Among them, option-pricing methods show promising developments for Intangibles' valuation. Section V advocates for an optional way for the evaluation of Intangibles. Finally, we suggest in our conclusion new paths of research for the evaluation of Intangibles.

I. Defining Intangibles through Intangible Assets and Intellectual Capital

A generic definition¹ for Intangible Assets (I.A), can be formulated as follows. Intangible Assets generally arise as a result of past events and possess three main attributes: they are non physical in nature, they are capable of producing future economic net benefits, and they are protected legally or through a de facto right. Table 1 gives some examples of the large variety of I.A.

<ul style="list-style-type: none"> • Marketing and customer related intangible assets: trademarks, brand names, logos, customers databases ... • Engineering and production related intangible assets: industrial design, product patents, technical know-how... • Human resources related intangible assets: assembled and trained workforce, employments plans... • Finances related intangible assets: 	<ul style="list-style-type: none"> • Copyright intangible assets: exclusive rights and protections on commercial, intellectual, artistic works... • Contract intangible assets: Distribution agreements, licensing and franchise rights, operating licenses, employment contracts... • Location intangible assets:
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planning and reporting systems relationships with shareholders, and with the financial community... • Data processing related intangible assets: System software, business operation applications, office automation, educational...	Easements, permits, leases, zoning waivers and variance, use rights (air, water, drilling, mining...) • Goodwill intangible assets: Existence of assets in place and ready to use, professional practice, celebrity or reputation...
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Table 1: Some examples of Intangible assets according to Reilly and Schweins

The IAS 38 describes under what conditions I.A should be recognized in the financial statements. The asset should be identifiable, controlled and clearly distinguishable from an enterprise's goodwill. The future economic benefits attributable to the asset will probably flow to the enterprise; and the cost of the asset can be measured reliably. IAS 38 frames the accounting recognition of I.A, but it does not qualify them from an economic perspective, and does not say what is indicative of their value.

The approach of Reilly and Schweins (1999) is helpful in its distinction between economic existence and economic value to evaluate I.A. I.A have *economic existence* if they should be identified, protected legally, and possess a right of private ownership that should be transferable. Nevertheless, economic existence does not mean that an I.A has *economic value*. For example, a registered trademark, which is not used in the production of income, has economic existence throughout its registration period but does not have economic value and cannot be considered as an I.A. Its value attribute should generate some measurable amount of economic benefit to its owner. Thus, it should potentially enhance the value of a pooling of other assets. To that extent, a registered trademark which does not produce any income but is used as a barrier to entry may have economic existence as well as economic value.

Lev (see Webber, 2000) remarks the 'extreme' difficulty to give an extensive definition of I.A. Understanding relationships between I.A and between intangible and tangible assets is crucial to define and evaluate I.A. It depends, in regards to the resource-based theory², on the specific environment in which Intangible Assets exist (Schendel, 1994), and on their unique assemblage within a firm (Hunt, 1997). A definition of Intangible Assets should state that they are non-physical in nature, specific to a business, and do possess economic existence as well as current -even if, it is indirect- economic value.

We will see next how to recognize Intellectual Capital.

The concept of Intellectual Capital (I.C.) is historically attributed to John K. Galbraith (1969).

It focused on dynamic constituents of assets that added value in their use to business requirements.

Nevertheless, one of the first and most complete structured descriptions of I.C. is due to the foremost Chief Knowledge Officer Edvinsson³ at Skandia AFS⁴ corporation. For Edvinsson and Malone (1997), Intellectual Capital is Human, Structural, and Customer-based.

From a valuation point of view, Sullivan (2000) gives a succinct definition of the Intellectual Capital. It is "*knowledge that can be converted into profit.*" How to make the conversion is the important point. According to Stewart (1997), "*intelligence becomes an asset when some useful order is created out of free brainpower.*" It is an "*intellectual material that has been formalized, captured, and leveraged to produce a higher-valued asset*" (Klein and Prusack, 1994). This intellectual material is the more often made of tacit knowledge embedded in the brain of employees and is not owned by the firm. This is why an explicit process must be applied prior to Human Capital, in order to create intellectual

assets, to which the firm can assert rights and ownership. However, the experience of Petrash (1996) at Dow Chemical shows Intellectual Property does exist but is often be widely unexploited. Intellectual assets contribute to building a valuable intellectual capital when they are organized for producing revenues. For Saint Onge, (1996) the way firms are turning their Human Capital into explicit knowledge and then into customer value determines their ability to compete.

Connecting intellectual assets with strategy is crucial. Stewart (1997) considers as a "vital lesson" that knowledge assets "exist and are worth cultivating only in the context of strategy." Intellectual capital cannot be defined and valued if the firm does not know what to do with. Knowledge needs to be "aligned" with its mission, vision, and strategy (Sullivan 2000).

To summarize, Intellectual Capital is a developmental knowledge that is human, structural, and customer- based, and needs to be aligned with the corporate strategy and formalized / packaged in some way.

A global definition of Intangibles should include an asset base mainly made of intellectual property and a knowledge base representing the Intellectual Capital.

II. The evaluation of Intangibles

The evaluation of Intangibles is a topic of great debate. Many authors⁵ criticize present approaches and point out the disconnection between the book and the stock value. They relate it to the incapacity of accounting and financial methods to capture the value of Intangibles. Under those circumstances several questions remain:

- What is the actual applicability of "well-accepted" accounting methods to the evaluation of Intangibles?
- How does the stock market evaluate Intangibles? What are the relevant methods?
- How can we measure the value creation for shareholders?
- What are the most worthy Intangibles: present and actual Intangible Assets and Intellectual Capital or their related portfolio of opportunities?

This paper addresses these questions by an extensive review of the literature. We review evidence that central theme running through all works related to Intangibles' evaluation are questions relating to *measurement and methods*. Our evaluating framework includes two coherent sets: "Global" and "Asset by Asset" approaches. Each set is detailed on the basis of its related methods in table 1.

MEASUREMENTS	<p>"Global" approaches</p> <ul style="list-style-type: none"> • Market to book value • Tobin's Q • Calculated Intangible Value • Total Value Creation method • Normalized Earnings method
	<p>"Asset by Asset" approaches</p> <ul style="list-style-type: none"> • Cost methods • Market methods • Income methods • Option-pricing methods
	METHODS

Table 1: Approaches applying to the evaluation of Intangibles

We will discuss "Asset by Asset" approaches and "Global" approaches next.

II. Evaluating Intangibles through Global approaches

The Market-to-Book Value is one of the most broadly known measurements of the intangible assets and intellectual capital. It is represented by the difference between the market value of the firm and its book equity. What makes its market value after accounting for tangible assets, are intangibles. This method is simple but has several problems in measurement and interpretation. The book value depends on the national or international accounting standard under which the accounts have been prepared. Historical cost,

modified historical cost for recording the tangible assets, or tax depreciation rates can strongly change a book value. Furthermore, the stock market is volatile and sometimes under or over states the value of a firm over a very short period of time. Does it mean that intangible assets do vary in the same proportions? How can we figure out if Intangible Assets of a company traded for more than its market value⁶ or less than its book value⁷? Does a deal, or a market change make Intangible Assets appear or disappear so easily?

The Market-to-Book method gives unreliable measures of the whole intangibles. However, it can be improved with the calculation of the Market-to-Book ratio. Compared with competitors or with an average value of the industry (its general trend may then globalize market shocks), this ratio could be used as a warning in year to year comparisons.

Tobin's Q is another popular measure of the value of intangibles of the firm, even if it was not initially conceived for this. Tobin (1978) considered that they indicated profitable investments or sell off opportunities. Wernerfelt and Montgomery (1988) related them to elements that stayed out of the balance sheet or strategic factors. Griliches (1981), followed by Hall (1988), Megna and Klock (1993) then Chung and Pruitt (1996) associated the Tobin's q to the existence of intangibles that were not recognized by book keeping. The Tobin's q compares, through a ratio, the market value of the firm to the replacement cost⁸ of its total assets. This ratio is a better one than the Market-to-book ratio; it neutralizes the effects of different depreciation policies. The more the ratio is above one, the more the firm shows strong returns on its investments. If the replacement cost of a company's assets is lower than its market value, then the company is getting monopoly revenues, or higher-than normal returns on its investment.

The Tobin's q is subject to the same exogenous variables that influence market price as well as the market-to-book method described above. Both of these methods are best suited to make comparisons of the value of firms' intangible assets within the same industry, serving the same markets, and having similar tangible assets.

The "Calculated Intangible Value"⁹ has been developed by NCI Research, affiliated with the Kellogg School of Business at Northwestern University. The approach was initially used by distilleries and breweries to estimate their loss of revenues and intangible assets that were due to prohibition. A Revenue Ruling (68-609) describes also, for tax purposes, a similar way for measuring the fair value of intangible assets (Luthy, 1998). The method consists briefly in calculating the Net Present Value (NPV) of the average excess Return On Assets (ROA) after taxes¹⁰. According to their authors, it measures a company's "ability to out-perform other companies in its industry." For us, this method is quite rough and circular. First, to attribute the out-performance solely to Intangible Assets is abusive; it is often linked, if not mixed, with implementation of tangible assets. Second, the investment cycle of a firm can be, for a period, out of line of its industry. This situation is not related to Intangible Assets and should not interfere with their valuation.

Tax and depreciation policies may introduce two additional biases regarding the amount of the pretax earning which affects the ROA. However, the major problem lies in the fact that the method seems to ignore the posting of Intangible Assets. Most of them are accounted for expenses and consequently reduce the pretax earning. Taking into account this inescapable fact, it seems quite specious to say that Intangible Assets might contribute

- if not in an indirect way - to the pretax earning enhancement and further to an *excess* rate of ROA. The Calculated Intangible Value method does not measure the value of Intangible Assets but rather gives a possible appreciation of the firm's investments profitability within its industry. It can be used as a tool for benchmarking performances of its *whole* assets.

The Total Value Creation method designed by the Canadian Institute of Chartered Accountants tries to track the value creation process through intangibles and is illustrated with an hypothetical biopharmaceutical example called "Greengene". The case study portrays the concept of a Total Value Creation database depending on the following components: (a) a value creation/realization formula, (b) a value stream model, (c) a value creation capacity assessment, (d) value creation for multiple key stakeholders measures. It is organized for value creation tracking and it gives an estimate of the corporate value creation related to Intangible Assets. The TVC approach is based on disclosure and analysis of outcome variance, the latter being the difference between total shareholders return¹¹ and a cost of capital return on opening Discounted Cash Flow (DCF) present value. It is equivalent to the Stern - Stewart concept of "Economic Value Added" (EVA) except it is not applied to GAAP plus adjustments but rather to DCF present value. According to their authors, the Value Stream Model is a "forward-looking approach," focused on future value streams rather than concerned with "sunk costs of the past." That's why "...'Assets' bound up in the business (such as laboratory equipment or such as cash fully committed to the future R&D 'cash burn') are not counted". The reason why - that is difficult to conceive in an "EVA" perspective - is that "it would be *double-counting* to value *both* the future cash flow stream *and* the assets giving rise to them". This is precisely what Stern and Stewart did when they determined the shareholder value of a firm in the "EVA" method¹². Investments in Intangible Assets - even if they are counted as expenses - must be part of the calculation of value.

The TVC method might be refined to be more consistent with its underlying model. We also think "*sunk costs* really have no bearing on the future or on the going-concern value of the enterprise", is a fashionable but questionable assumption. The new "P to P" (Path to Profit) demand on internet stocks shows, for example, that shareholders do bother about sunk costs and associated heavy losses. Those sunk costs are counterparts of most Intangibles and need to be taken into account in a valuation perspective. Nevertheless, we believe the Canadian Performance Reporting Initiative is a great idea. The interest of the TVC method is to propose an integrated valuation process in an experimental format, arousing reflections and debates. In addition, the "Greengene II" case study is a powerful instrument for educational purpose in the field of the valuation of intangibles.

The "Normalized Earnings" and the "Knowledge Capital" designed at CFO Magazine's request by Professor Baruch Lev of the Stern School of Business at NYU, proposes new paths to measure the earnings impact resulting from knowledge-based activities. The method starts with an estimate of annual "Normalized Earnings"¹³, and then it subtracts from them an average expected return after-tax on tangible assets¹⁴, and on financial assets¹⁵. Residuals, called "Knowledge Capital Earnings"(KCE) are what remains as the knowledge earnings that are created by the knowledge assets. The next step consists in the calculation of the "Knowledge capital" which is given by the present value of all KCE, discounted at an appropriate rate¹⁶. Finally, the total "Comprehensive Value"

totalizes the value of the knowledge capital and the book value. This measure takes into account both tangible and intangible assets and gives the global value of the firm.

These calculations suggest several new financial ratios and their evolution, such as Knowledge Capital / book value¹⁷, market value / Comprehensive Value¹⁸ or a "Knowledge Capital Margin" (KCE / sales)¹⁹. Grouped in the "Knowledge Capital Scoreboard," they have been applied first (see Lev and Mintz, 1999) to a sample of pharmaceutical²⁰ and chemical²¹ companies. They provide interesting results concerning the evaluation of Intangibles throughout an industry and from one industry to another. Size and industry count: largest companies own more knowledge assets than smaller ones; pharmaceutical companies compared to chemical ones occupy the higher end of the spectrum.

The second annual Knowledge Capital Scoreboard (see Mintz, 2000) extends the scoreboard to 18 industries from aerospace to telecom and gives industry rankings for median knowledge capital earnings. The scoreboard also explores relations between kinds of "investments" in knowledge capital and change in knowledge capital earnings. It identifies three essential drivers of performance: research & development, advertising, and capital expenditure. Growth in knowledge earnings shows also a strong and positive correlation with the market value.

However, the method could provide incoherent results: take for example a company "A" which does not invest at all or very weakly during the period (or part of the period) of evaluation. It should present greater earnings (because investments in knowledge are broadly expensed) than a firm "B" which invest in knowledge assets. Through the proposed calculation, the Knowledge Capital of the company "A" would grow (without investments?) and the one of the company "B" would contract because of its investments in! The only way to fix it is to proceed to an adjustment on expenses in knowledge assets. They must come in addition to normalized earnings in order to give *Adjusted* "Normalized Earnings," and consequently, an *Adjusted* "Comprehensive Value."

III. Evaluating Intangibles through Asset by Asset approaches

Cost methods are classical approaches for Intangibles' individual appraisal. Among them, several related analytical techniques (creation / recreation, historical / prospective, reproduction/replacement, avoidance cost...) are relevant for their evaluation. However, the most common are reproduction cost and replacementcost (Reilly and Schweihs, 1999). The reproduction cost and the replacement cost provide a "reasonable" measure of the value of intangibles when two conditions are met. The first one is to include all the cost components of the intangible; the second one (unless it is brand new) is to reduce it for all forms of obsolescence.

Putting together all the cost components is the more step when it applies to Intangibles because they are resulting from multiple and accumulated expenses and are often closely associated to tangible assets. The common way takes into account materials, labor and overheads. It must also include the developer's profit and an entrepreneurial incentivewhich are difficult to appreciate for Intangible Assets regarding their more often indistinct nature and their associated uncertainty. Choosing the right costs of reference also raises questions. Historical costs may be objective, consistent and reliable, but suffer from

practical limitations. There is often a lack of relevant information for older intangibles. Expenditures incurred in maintaining the value of an intangible asset and investments in enhancing its value can not be differentiated. The historical cost reflects a particular situation of prices on a market and adjustments should not reflect current prices. The main strength of the replacement and recreation costs is to surmount this difficulty. Therefore, they do not fix the problem of the present required costs of recreating the intangible. Intangible Assets are associated with a history that largely determines their attributes. Those could be currently impossible to replicate and some intangible assets might be irreplaceable (Andersen, 1992).

Identifying and measuring obsolescence is also an acute operation in order to estimate the value of an Intangible Asset. The common forms of obsolescence include²² functional²³, technical²⁴ and external²⁵ ones. Their measurement requires a particular care, in order to separate obsolescence related to the Intangible Asset from the associated tangible asset, and to use only the obsolescence related to the intangible. Qualitative methods, such as the "Life Cycle Analysis" and the "Remaining Useful Life" (Nelson, 1982; Ellsworth, 1992; Garbarino and Smith, 1993; Fuller, 1994; Paschall, 1994) can assist in appreciating the obsolescence of an intangible.

The main limit of costs related methods lies in their fundamental and implicit assumption that expenditures should always create value. This assumption (Andersen, 1992) "may be untenable given the variable success of new intangible assets (eg: brands) brought to the market". This is why the evaluation of Intangible Assets might also use market or income approaches.

Market methods estimate the market value of an Intangible Asset by comparing it to similar intangibles, that have been licensed or sold in recent times. Market approaches include²⁶: the Sales Transaction Method²⁷, the Relief from Royalty method²⁸, the Comparative Income Differential method²⁹, and the Market Replacement Cost method³⁰. Even if their implementation depends on available information and reliable transactional data, those methods represent the most direct and efficient approaches to the valuation of Intangibles. Their practical application (see Arthur Andersen, 1992) do have some limitations due to the following several factors: (a) most intangibles are not sufficiently traded to determine a comparable market value, (b) they are more frequently traded with a business including tangible assets and are difficult to dissociate from, and (c) they may be unique and similar transactions do not exist. In addition, market cycles, or purchaser's special interests, such as strategic or competitive premiums, may introduce distortions. Because of these, analysts consider adjustments on those factors as "vital" for making the market approach relevant.

The most applicable standard of value in market approaches is nevertheless the "fair" market value. When selecting and analyzing guideline sales or license transactions, the following elements (see Mullen, 1993; Smith, 1994; Battersby and Grimes, 1996; Reilly and Schweihs, 1999) usually require careful consideration: appraisal of the property rights, motivations to the transaction, financing terms, market conditions, size, attributes, and economic situation at the time of sale. The market value is usually given by the application of a multiple to the price of the guideline transaction, or the application of some relevant variable coming from: the guideline transaction's financial statements, the market potential, or projections of future earnings. Their choice may appear subjective, such as the different

elements of comparison seen above. Those are often especially difficult to collect for Intangible Assets, due to their unique character and their possible lack of marketability. They represent severe difficulties when implementing market approaches.

Income methods can be grouped into two categories: the yield capitalization method and the direct capitalization method. The first one calculates the present value of a non constant stream of projected economic income flows over a discrete time period. The second one capitalizes a constant, or constantly changing stream of economic income flows, over a specific time period. Income approaches are adaptable to virtually any type of intangible. They are possibly among the most accurate and controlled evaluation's methods. They require however (Reilly and Schweih, 1999) to consider all the critical economic variables associated with Intangibles including: (a) the income generating capacity, (b) the expected remaining life of the intangible, and (c) the appropriate cost of capital for an investment in the Intangible Asset, and the risk associated with the intangible. All of these variables are considered implicitly in the other methods, but need to be explicitly addressed in the income methods.

The income allocation between the Intangible Asset and the associated tangible asset is a prerequisite to the measurement of the income generating capacity. Another important step for a consistent evaluation is to identify clearly the origin and the production mechanism of the income. The potential sources of incomes of an Intangible Asset are the same than tangible ones³¹ and may occur through the use, ownership or forbearance of use of the intangible. License agreements typically illustrate the different incomes coming from their respective use or ownership, and are quiet easy to measure. Forbearance of use (but ownership) of a trademark, patent or technology for defensive purposes³² does generate indirect incomes but are much more problematic to evaluate.

The correct appreciation of the expected remaining life of the intangible is a second tricky issue. This is especially important when applying yield capitalization methods, but also true for direct capitalization methods implementation. The number of periodic income flows to be projected depends on the length of the time period of the evaluation. This is why life analysis must be used and the remaining useful time of the Intangible Asset must be estimated. According to Wayne (1982), Dandekar and Cowles (1987), Reilly (1991), the value estimation of incomes depends on the duration of the life period. For instance, the conclusion of the income method is very sensitive to variations in remaining useful life when the life estimate is under ten years, and has no effect when the life estimate is above twenty years. Some quantitative analysis may help to define the appropriate life characteristics of an intangible. For example, customer-related intangible assets can perform actuarial techniques such as Survivor Curves analysis, if age data on customers or contracts renewal are available.

The choice of appropriate capitalization rates is a third important issue in the application of income methods, even if there is no radical difference when applying to intangible rather than to tangible assets. There are two kinds of capitalization rates: yield capitalization rates and direct capitalization rates. Both of them should include to the extent possible: (a) market-derived data, (b) forward-oriented data, (c) risk appreciation, and (d) consistency with the measure and the term of income stream. The multiplicity of the variables involved in income approaches may make them heavy to process, particularly when the income -or a part of it- is indirect.

The most serious limitations that are shared by the cost, market or income approaches lie in the static way they consider Intangibles. They fundamentally consider them as given. Traditional asset by asset methods do not evaluate (unless indirectly with rules of thumb or discrete adjustments) Intangibles through the risks/opportunities that are embedded in them. Those correspond very often to the most important part of their value, if not to their whole or sole value. Because of this, we will now explore and strongly advocate for the option-pricing approach in the valuation of Intangibles.

IV. Advocating for an Optional Way

Myers (1984) was the first to recommend the application of the option-pricing theory to the valuation of a particular Intangible Asset that was R&D. He states the Discounted Cash flows method (DCF) is of "no help at all" and "the value of R&D is almost all option value". Evaluating R&D with DCF methods has been criticized by several authors. Hayes and Habernathy (1980) identified the DCF analysis as a contributing factor to the decline in R&D spending in the United States during the seventies. Hayes and Garvin (1982) related it to the misuse of DCF approaches then Hodder and Riggs (1985) demonstrated it with an example. Kaplan (1986), through investment cases, concluded that DCF methods were unable to take account of the value of "intangible benefits" such as flexibility and learning.

According to Baldwin and Trigeorgis (1993), the solution to under-investment and lack of competitiveness should be found in the management of real options, and Faulkner (1996), analyzing the Japanese investment decisions, advises to apply real option pricing methods for evaluation of R&D investments. For Dixit and Pindick (1995), managers need to consider the value of their options open to make intelligent investment choices and Nichols (1994) reports a "scientific approach" to finance³³ should consider all business decisions are real options. It is in a "continual redefinition of the opportunities created by the resolution of uncertainty" (Faulkner, 1996) that managers enhance the intangible value of a firm and Luehrman (1997) states that opportunities are often the most valuable assets they have. The point is how to identify this "intangible value" represented by opportunities that are real options.

Several conceptual real-options frameworks have been presented by different authors such as Kester (1984), Mason and Merton (1985), Trigeorgis and Mason (1987), Kulatilaka and Marcus (1988), Trigeorgis (1988), Kulatilaka and Marks (1988). Copeland and al. (1994) classify real-options into five categories: (a) the option to abandon or sell an asset (equivalent to an American put option on stock), (b) the option to defer its development (equivalent to an American call or put option on stock), (c) the option to expand or contract the scale of an asset (equivalent to an American call or put option), and (d) the option to switch project operations (that is a portfolio of both put and call options).

The recent literature shows many ways to evaluate, under different circumstances, the price of real-options, including several degrees of sophistication. We will not discuss each of them in details. Briefly, real options can be evaluated in two ways: separately with the valuation of one type of option at a time, or through their combination when their values

may interrelate. In the first case, authors such as Myers and Madj (1990) examine the option to abandon, Mc Donald and Siegel (1986), Majd and Pindyck (1987) or Paddock and al. (1988) investigate the option to defer. Margrabe (1978), Kulatilaka and Trigeorgis (1993) analyze the option to switch. A contribution that can not be ignored comes from Trigeorgis (1991, 1993) where each previous type of options is evaluated separately and then in combination.

However, Trigeorgis (1993) draws our attention to the difficulty of numerical techniques³⁴ -called "the bitter pill"- that are sometimes necessary to describe complex options situations. Concerning one of the well known and direct approaches using the Black and Scholes formula, Faulkner (1996) points out that its perceived complexity and its "often counter-intuitive result" is a barrier to use for most managers. Leslie and Michaels (1998) state that the reason for its apparent neglect may be that options theory is "notoriously arcane". Nevertheless, they agree to the fact that the formula can be computed easily, and prove it through comprehensive examples. That is not to say that the Black and Scholes formula should apply to any case, no more than a popular alternative method that is the decision-tree analysis. Each of them shows strengths and limits. Even if the Black and Scholes formula for the valuation of the R&D (see Brealey and Myers, 1988) is quite fast and easy, such a simplifying assumption as the future outcomes' uncertainty of research, development and commercialization operations could be described by a single log normal distribution, is arguable. On the other hand, even if the uncertainty may be customized in any manner with the decision-tree analysis³⁵, this technique is often heavy to implement, and may generate too large and complex representations.

Beyond the valuation techniques, applying the option-pricing approach to the evaluation of Intangibles introduces a new insight in the way to conceive, assess and manage them. Faulkner (1996) strongly advocates for an "options thinking" recognizing that uncertainty, when it generates opportunities and limited risks, may correspond to the true and most important value of an investment's project. It is obvious to point out in the actual and present business environment, that uncertainty is almost everywhere and applies to any asset. Intangibles conceived as options on real assets may be *potentially* anywhere. From our point of view, Intangibles are all options on tangible assets, Intangible Assets and Intellectual Capital. In this perspective, uncertainty and its associated risks and opportunities might be the present and worthy Intangible of a firm, if it generates flexibility. For Trigeorgis (1993), management's flexibility is strategic and operating capacity to adapt actions to environmental changes, "expands an investment opportunity's value by improving its upside potential while limiting downside losses". An 'expanded or strategic' Net Present Value (NPV) of any investment should include: (a) a classical NPV calculated under passive management hypothesis, plus (b) the value of options from active (or adaptative) management. In fact, flexibility might add to any asset -intangible or not- an "intangible value," if the cost of the real option is lower than the benefits it should provide.

There are several empirical works examining advantages in terms of the value creation of an "option thinking" (Faulkner, 1996). Kemna (1993) reports three cases of investment opportunities for Shell Company that benefited from applying option-pricing techniques. Leslie and Michaels (1998) examine their positive impact on BP³⁶ and PowerGen. Herath and Park (1999) also develop a valuation model incorporating the risk-free arbitrage features of the binomial option pricing model into a decision framework and apply it to the

introduction of a new product: the new Mach III from Gillette. They demonstrate the value of innovation and its impact on the stock value³⁷.

Option-pricing approaches are going far further into the problematic of evaluation. Options on intangibles and assets may also represent *the Value* of Intangibles. Current definitions of Intangibles are all assets and knowledge-based. Regarding our previous discussion and the global and growing uncertainty of our environment, we think this way to conceive Intangibles is incompleting. Uncertainty is everywhere and may apply to any asset or knowledge capital. Because of this, we think Intangibles must include a third dimension, that is optional, and which applies to tangible and intangible capitals. Intangibles are made of assets, knowledge, and options.

This conception of Intangibles introduces new paths for their evaluation. Applying to the intangible part -which is optional- of any asset or capital, it radically changes the field of intangibles' evaluation. Therefore, we suggest extending the evaluation of Intangibles to what we call the *Optional Capital* of the firm. We represent the *Optional Capital* as composed of a portfolio of different possible options on Intangible Assets and Intellectual Capital but also on Tangible and Financial Capital. These are options to sell or buy, options to expand or contract, options to differ an investment in, and options to switch. As regards ubiquity of options, we recommend to place the *Optional Capital* at the core of an extended model for evaluating Intangibles. It interrelates with the tangible and financial capital but also interacts with the three components of Intangibles encompassing Human, Structural, and External Capital.

Conclusions and perspectives for future research

The aim of this paper was, at its origin, to explore Intangibles and provide a theoretical survey of current and emerging approaches for their evaluation. The preliminary step for the evaluation of Intangibles was to give a definition of them. We think now a complete definition of Intangibles does encompass the concepts of Intangible Assets, Intellectual Capital, and "Optional Capital." A second step consisted in a review of an extensive, if necessarily incomplete bibliography of related research that should be contributive to a complete evaluation of Intangibles. Their organization into "Global" and "Asset by Asset" approaches improve their visibility. A third step the discussion of approaches to appreciate their respective contributions. A final review and assessment indicates several promising research areas.

Among Stock Market approaches the "Total Value Creation" method and the "Normalized Earnings" represent works of particular interest. The first one needs to get deeper into the value creation measurement for shareholders, the second one requires to be adjusted and experimented on a wider range, to become a reference approach.

Assets by Asset approaches are only at their early beginnings for the evaluation of Intangibles. As discussed previously, accounting related methods might be disconnected with economic reality. Even if accountancy has to cope with standards applied to Intangible Assets, it must improve present practices. It is necessary to refine the recording of Intangibles, deepen depreciation techniques and justify them economically. Opening

accountancy related fields such as cost control, budgeting, consolidation, pooling... that presently ignore Intangibles, are fruitful ground for future research and experimentation.

The application of the option-pricing theory to the evaluation of all Intangibles merits further explorations and needs to be experiment. For us, *Intangibles are also options*. To that extent the basic point lies beyond methods and measures. Evaluating Intangibles through an optional way could finally suggest that raising uncertainty over tangible and intangible assets is a manner to exercise their real value.

NOTES

¹ -see Arthur Andersen, 1992-

² - see among others: Hamel and Prahalad, 1989, 1993; Wernerfelt, 1984, 1995; Leonard, 1998 Miles and al.1998-

³ - see also Edvinsson, L. and Sullivan, P. (1996) "Developing Model For Managing Intellectual Capital" -

⁴ - which is one of the leading Swedish insurance company-

⁵ - see among them: Sveiby (1997); Roos and al.(1998); Lev (1999, 2000) -

⁶ - such as in many cases of mergers and acquisitions-

⁷ - some market values of internet stocks dropped under their book values -

⁸ - reported value plus accumulated depreciation, plus account for inflation-

⁹ - reported by Stewart, 1997, as due to Thomas Parkinson and James Peterson-

¹⁰ - The original version calculated the CIV in 7 steps: 1) calculate for the last 3 years the average Return On Assets (ROA) of the company; 2) compare this ROA to the average ROA of the industry (use figures from Morris Associate's Annual Statement Studies); 3)multiply the industry average ROA by the company's average tangible assets; 4) subtract that result from the average pretax earning of the company and obtain an "excess return"; 5) subtract an average income tax and calculate an after tax excess of return; 6)calculate with an appropriate rate the Net Present Value of this after tax excess of return; 7) the result gives the value of intangible assets called CIV.

¹¹ - dividends plus the change in Discounted Cash Flow (DCF) present value -

¹² - the value for the shareholder is invested capital plus the Net Present Value of the three to five EVAs plus a terminal value -

¹³ - They encompass the three past years of historical data and earnings consensus forecasts (from IBES International consensus estimates) for the next three years with a little greater weight to earnings forecasts (taking into account business changes that could affect future results)

¹⁴ - for 7 percent -

¹⁵ - for 4,5 percent -

¹⁶ -10, 5 percent after taxes - This rate is a proxy of the average after tax rate of return for three knowledge intensive industries: biotechnology, pharmaceuticals and software -

¹⁷ - "which measures the degree to which a firm is knowledge-based" (see Lev and Mintz, 1999) -

¹⁸ - which measures the degree to which the market reward investments in knowledge and its expectations of knowledge earnings -

¹⁹ - shows the contribution of knowledge capital assets to overall performance (see Lev and Mintz, 1999) -

²⁰ - 20 pharmaceutical firms with sales in excess of \$ 250 million -

-
- ²¹ - 27 chemical firms with sales in excess of \$ 1 billion -
- ²² - physical deterioration usually does not apply-
- ²³ - functional obsolescence of an intangible asset is due to its inability to perform the function for which it was originally designed -
- ²⁴ - technological obsolescence is due to improvements in design, engineering ...technology -
- ²⁵ - external obsolescence is generally considered to have 2 components: location related and economic related obsolescence. Those are both due to not controlled effects, events or conditions that affect the current use or condition of an intangible asset -
- ²⁶ - we exclude here rules of thumb that seems to us quite obscure and too much specific to industry valuation "formulas"-
- ²⁷ - based on actual market transactions -
- ²⁸ - based on the royalty income the intangible would generate if the intangible was licensed in arm's length transactions -
- ²⁹ - based on the comparison of the income produced with and without operating the intangible -
- ³⁰ - based on the estimate of the replacement cost of the intangible by knowledgeable outsiders or external expertise -
- ³¹ - they derive from increases in revenues, decreases of expenses and decreases of investments.
- ³² - as for example the protection of other intangible assets or competitive position-
- ³³ -as the CFO J. Lewent takes at Merck-
- ³⁴ - The article provides numerous references on the two sets of numerical techniques for option valuation that are, according to Trigeorgis, (1) approximating the underlying stochastic processes directly, or (2) approximating the resulting partial equations-
- ³⁵ - see Herath and Park, 1999 for an application to the new Mach III from Gillette-
- ³⁶ - between 1990 and 1996, BP increased its market value that represented a total return to shareholders of 167% and PowerGen of 300%.
- ³⁷ - from September 1997 (when Gillette announced the launch of the Mach III) to April 1998 the stock of the company had increased 50%.

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