ICEB 2003 Proceedings

International Conference on Electronic Business (ICEB)

Winter 12-9-2003

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Abstract

The purpose of this work is to show that the use of real options can contribute to a better evaluation of companies devoted to Electronic Commerce – Business-to-Business. For such, usual company-evaluation techniques are presented and the advantages and disadvantages of each one are discussed, with emphasis to the real-option technique. Additionally, the similarity between asset investment and call options is shown, and internal and external real options existing in a Business-to-Business company are identified. Finally, this work describes how to evaluate a company acting in Business-to-Business by employing the concepts of real-option theory.

1. Introduction

In recent years, the development of Internet-bound technology has yielded the extraordinary growth of Electronic Commerce among companies, called Business-to-Business (B2B), leading to the constitution of several electronic marketplaces. Transactions among companies have become faster and safer and have had their costs reduced, attracting a larger number of purchasers and suppliers into this new business environment.

Despite many successful stories of B2B companies created in the past few years, their growth has been facing difficulties due to technical, organizational, economical and legal challenges. Such uncertainty scenario has lead to a significant loss in the value of such companies.

The new economy has revolutionized traditional evaluation theories. While in the old economy evaluation models were based on tangible assets, such as factories, machinery and finished products in stock, in the new economy intangible assets, such as intellectual capital or clients, have also started to be computed as company values.

The evaluation of Internet companies has been greatly affected by the uncertainty of markets. The impossibility to foresee how companies will perform in the future makes the evaluation of these companies using traditional methods inadequate because these methods do not consider managerial flexibility. A new trend in evaluation methods concentrates in the exploration of uncertainty, approaching businesses or investments as real options.

This work presents a proposal for evaluating B2B Internet companies that takes into consideration the existing uncertainties in the Internet B2B environment by applying the real-options theory.

First, we present the traditional methods for evaluating Internet companies. Then, we emphasize the positive and negative aspects of each method. Next, we present a typical configuration of the environment where B2B companies operate and the existing relationship dynamics between a given company and all other companies with which it interacts. Based on this configuration, we show the existing internal and external options that add value to that company.

2. Usual Evaluation Methods for Uncertainty Environments

The mostly used methods for evaluating companies in uncertainty environments are (Trigeorgis, 1996):

- Discounted Cash Flow
- Sensitivity Analysis
- Simulation
- Decision-Tree Analysis
- Real Options

2.1. Discounted Cash Flow

In the absence of managerial flexibility, the discounted cash flow is the best method to calculate the value of a company (Trigeorgis, 1996).

The discounted cash flow analysis – DCF – is the tool mostly used by academics and by analysts in order to evaluate investments, especially because it is a method easy to understand. However, DCF does not deal in a convenient way with strategic factors emerged from future uncertainty and the flexibility companies makes use of to respond to situations different from the ones expected (Teisberg, 1995).

A dynamic version for DCF was created by McKinsey (Desmet et al., 2000) in order to deal with future uncertainty. This version, instead of assuming a unique future cash flow deriving from a set of predetermined decisions, takes into account that the analyst initially assumes a set of future uncertainties and contingent decisions, translating them into alternative scenarios. These scenarios can be expressed together in a decision tree. Then the probability of each scenario is evaluated.

These probabilities are obtained from the analysis of similar projects or by means of macroeconomic analysis.

Both methods, static and dynamic DCF, use a unique discount rate adjusted to the perceived risk. The evaluation of the discount rate is usually based on data from projects with a similar risk – or, ideally, with identical risk. However, the use of only one discount rate has some problems. The relative risk of an enterprise can vary for each different scenario, or even for different project stages. As an example, we can observe in some exporting companies that some of their costs can have different risks if compared with revenue risks because they can be exposed to currency risks when their raw material derives from the domestic market. Therefore, it is advisable to use more than one discount rate in the analysis of this kind of project (Luerhman, 1998, p. 60).

One of the best examples of the dynamic version of DCF was created by McKinsey in order to evaluate Amazon.com (Desmet et al., 2000). In this example, McKinsey has combined the classic DCF method, microeconomic analysis and probability-weighted scenarios.

2.2. Sensitivity Analysis

The net present value of a project is a function of the forecasts of some variables: the project's life, salvage values, product prices, production costs, size and growth of the market and others.

Sensitivity analysis is the process of investigating these forecasts in order to identify the key variables and determine the impact of each of these primary variables on the net present value of the project. The sensitivity analysis is made by varying the value of the primary variable selected, holding other variables unchanged. (Trigoergis, 1996, pg 52.)

The sensitivity analysis is important to identify the variable that contributes the most to the investment's risk. A variable can have a high variance compared with other variables (higher risk) but make an insignificant contribution to the project's risk and, thus, we can consider that investment decisions are independent from a very accurate precision in its estimate. On the other hand, if a variable has a low risk, it can demand a better estimate of its value. Therefore, if we commit errors in its estimate they can generate significant impact on the project's value. The relevance of each variable will indicate the necessity or not to spend more time or money in it to attain information in order to contribute to the reduction of the uncertainty of the project as a whole.

The sensitivity analysis also has some limitations. It considers the effects on the net present value at a time ignoring the possibility of interdependencies between variables, that is, the effects of the variation of a variable on other variables. In this case, the result might be underestimated, not corresponding to the results that would occur in practice. Another limitation is that a variable can present a dependency in time that is an error in the estimate of one year, which can spread to the following years causing great impact on the net present value.

When variables are interdependent, it is necessary to examine the project's net present value according to alternative scenarios with the simultaneous variation of a limited number of variables as a function of their interdependence.

2.3. Simulation

The simulation technique is used in the attempt to imitate managerial decisions in the real world. In order to obtain the desired results, a mathematical model is developed holding equations that represent the operations accomplished by the system being analyzed. This model must capture the most significant characteristics of the project as it evolves in time and encounters random events. The Monte Carlo method is the traditional method used in simulation. It includes the following steps:

- The project is modeled by means of a set of mathematical equations and identities contemplating the more significant primary variables;
- Probability distributions are specified for each of the above variables in a subjective way or from past empirical data;
- A random sample is then drawn from the probability distribution for each variable, allowing the calculation of the net cash flow for each period;
- The process is repeated until the average and standard deviation of the net present value can be obtained.

Although this procedure can handle sophisticated models, it has some limitations: (Trigeorgis, 1996, pg. 55):

- It is difficult to estimate the probability distribution for each significant variable.
- Even if the probabilities were determined, it is difficult to capture and shape all the interdependencies among the variables of the model.
- If the result of the simulation is a risk profile of net present value, the meaning of an outcome probability distribution of the NPV is questionable, since it is not clear what discount rate should be used.
- The management cannot easily translate the risk profile into clear decisions for action.
- Using the variability of project outcome as a measure of risk instead of the systematic risk, which would be the most appropriate risk for the company's shareholders, is dangerous.
- In some situations, the management can assume that a group of projects is viable when analyzed as a group, even when some of them are individually unacceptable.

2.4. Decision-Tree Analysis

Decision-tree analysis is a methodology that attempts to account for uncertainty and the possibility of subsequent decisions by the management. It helps the management to structure the decision problem by means of mapping all the dependent alternative courses of action. This methodology is especially applicable to analyze complex decisions of sequential investments when the uncertainty is decided in different points in time.

The decision-tree analysis is a good methodology for analyzing sequential investment decisions when uncertainty is resolved at diverse points in time. It forces the management to recognize the interdependencies between the immediate decision and subsequent ones.

Although this method is sufficiently flexible, allowing the representation of the managerial flexibility found in practice, it has practical limitations. For example, decision-tree analysis can quickly become very complex if the number of paths through the tree increases too much motivated by the number of decisions. Another problem is the difficulty to determine the appropriate discount rate.

2.5. Real Options

Options are contracts that give their holder the right, but not the obligation, to buy (call option) or to sell (put option) an asset at a predetermined price (exercise price) on or before a specified date (expiration or maturity date). For a call option, when the exercise price is above the market price of the asset, the option is said *out-of-the-money*. Conversely, if the market price of the asset is above the exercise price, the option is said *in-the-money*.

An option is called American option if it allows its owner to exert the option before the maturity date. It is called European option if it can be exercised only at the maturity date.

We can find different models to estimate a price for an option with sufficient precision. The mostly known models are the binomial model developed by Cox, Ross and Rubinstein (1979), and the Black-Scholes model (1973).

The evaluation of an option is based on the following premises (Weston, Copeland, 1992, p. 446):

- Frictionless capital markets (for actions, headings and options). This means: a) they do not have transaction costs or taxes; b) there are no restrictions on short sales; c) all shares of all securities are infinitely divisible; and d) borrowing and lending are unrestricted.
- Asset prices obey stationary stochastic processes along time.
- Risk-free rate is constant along time.
- Underlying assets pay no dividends.

Most of these premises can be relaxed without changing the basics of the option pricing model.

2.5.1. Binomial Model

The binomial option pricing model is a discrete model along time. This model starts by reducing the possible option price modifications for the following period to two: price can move up or down from its current level. This simplification is acceptable if the period of time is very short, so that a great number of small movements is accumulated along the option's life (Brealey, Myers 1992). Thus, for a one-period model, the investor assumes that the price of the action – S – at the end of the period can have one of two values: uS with probability q or dS with probability $1 - q$. Let C be the current value of a purchase option; C_u and C_d the value of the call option at the end of the period if the option price is equal to uS and dS, respectively. In the one-period model, the option expires at the end of the period, and then the option's value in maturity date equals $C_u = \max(0, US - X)$, X being the option's exercise price, with probability q and $C_d = \max(0, dS - X)$ with probability $1 – q$.

This procedure can be easily extended to multiple periods. If the time to the option's expiration, τ, is subdivided in n equal subintervals, each of length $h = t / n$, and the same valuation process is repeated starting at the expiration date and working backwards recursively, the general multiplicative binomial option-pricing price for n periods will be:

$$C = \frac{\sum_{j=0}^{n} \frac{n!}{j!(n-j)!} p^j (1-p)^{n-j} \max(u^j d^{n-j} S - X, 0)}{(1+r)^n}$$

The first part, $\{ n! \div [j! (n - j)!] \} p^j (1 - p)^{n - j}$, is the binomial distribution formula giving the probability that the stock will take j upward jumps in n steps, each with probability p. The last part, $\max (u^j d^{n - j} S - X, 0)$, gives the value of the call option at expiration conditioned to the stock following j ups, each by u %, and $n - j$ downs each by d % within n periods. The summation of all possible option values at expiration multiplied by the respective probability of occurrence (j = 0...., n), gives the expected terminal option value, which is then discounted at the riskless rate over the n periods (Trigeorgis, 1996, p. 85).

2.5.2. Black-Scholes Model

In 1973, Black and Scholes presented a rigorous method to value stock options based on the premise of risk-free arbitrage. The term *risk-free arbitrage* means that investments which have the same risk/return rate must be equally priced. If it is possible to determine the payments of a risky investment and then to construct a portfolio with other investments that offers exactly the same payments, then the price of the two assets must be equal. If the prices are not equal, then the occurrence of arbitrage is possible, that is, purchasing an asset by a lower price and selling the same asset for a higher price.

The Black-Scholes model formula is:

$$C = S\, N(d_1) - X e^{-rf\,T} N(d_2),$$

where

$$d_1 = \frac{\ln(S/X) + rf\,T}{s\ Ö\ T} + \frac{1}{2}\, s\ Ö\ T$$

$$d_2 = d_1 - s\ Ö\ T$$

$N(d_1)$ and $N(d_2)$, respectively, are the cumulative standard normal distribution function of a unit's normal variable d_1 and d_2; S is the price of the asset; X is the exercise price; T is time to maturity; σ^2 is the return volatility of the asset; rf is the risk-free rate; and e is the base of natural logarithms, constant = 2,1728...

The Black-Scholes model was developed over of some hypotheses that introduce some limitations to its use. The Black-Scholes model assumes (Copeland and Antikarov, 2001, p. 106):

- The option alone may be exercised only at maturity (European option).
- There is only one source of uncertainty.
- The option is contingent on a single underlying risky asset.
- The underlying asset pays no dividends.
- The current market price and the stochastic process followed by the underlying assets are known (observable).
- The return variance on the underlying assets is constant through time.
- The exercise price is known and constant.

The payment of dividends reduces stock price. Consequently, call options will become less valuable and, conversely, put options more valuable as dividend payments increase. Damodaran (Damodaran, 1997, p. 735) presents an adjustment for dividends when valuing short-term options and another for long-term options. He also suggests some other adjustments that allow calculating the value of an option for an early exercise.

For short-term options, that is, within a short time before expiration (less than one year):

Adjusted stock price = Current asset value - Present value of the expected dividends or

$$S' = S - S \frac{\text{Div}_t}{(1+r)^t}$$

$$C = S' N(d_1) - X e^{-rt} N(d_2)$$

where:

$$d_1 = \frac{\ln(S'/X) + rf\,T}{\sigma\sqrt{T}} + \frac{1}{2}\sigma\sqrt{T}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

For the long-term period, assuming that the dividend yield (dividend yield = y = share/current asset value) is expected to remain constant during the option's life, the Black-Scholes model can be expressed as:

$$C = S e^{-yt} N(d_1) - X e^{-rt} N(d_2)$$

where:

$$d_1 = \frac{\ln(S/X) + (rf - y)\,T}{\sigma\sqrt{T}} + \frac{1}{2}\sigma\sqrt{T}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

The adjustments in the Black-Scholes formula have two effects: a) the asset value is discounted back to the present at the dividend yield to take into account the expected drop in value from dividend payment; and b) the interest rate is offset by the dividend yield to reflect the lower carrying cost from holding the stock.

2.5.3. Mapping a Project onto an Option

An investment opportunity is similar to a call option because the company has the right, but not the obligation, to acquire the asset as, for example, a new business. So, if it is possible to determine options that are similar to investment opportunities, the values of these options can be taken as reference for the value of these investments. Given the characteristics of an investment, it is very difficult to obtain a similar option. Thus, the only trustworthy way of getting the desired option is by means of the construction of an option. In order to obtain such option, it is necessary to establish a correspondence between the characteristics of the investment opportunity and the variables that determine the value of a call option (Luehrman, 1998, p. 52). Figure 1 shows the mapping of an investment opportunity onto a call option.

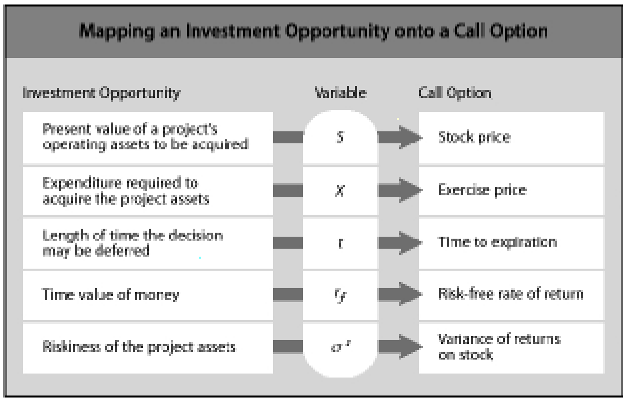

Figure 1: Mapping an investment opportunity onto a call option
Source: Investment Opportunities Real Options: Getting Started on the Numbers, Luehrman, T. A., Harvard Business Review, July-August, 1998

The net present value of an investment opportunity is the difference between its net present value S and how much it costs, NPV = $S - X$. When the NPV is positive the investment adds value to the business. Conversely, if it is negative, the company does not invest in this new opportunity, that is, NPV = 0. In terms of real options, this result can be expressed as being the value of the call option = $S - X$.

In the traditional methods of asset evaluation, managerial flexibility is not taken into account. Managerial flexibility is similar to a deferral option and adds value to the investment opportunity. By means of deferment the company postpones the outlay relative to the investment and, by applying this amount, it earns the value of the money in time and creates the possibility to do the investment later in case the asset value goes up. If the last alternative occurs the company can exercise the option. If, in contrast, the asset value decreases, it can either abandon the business or wait to see if its value goes up in time, avoiding loss of money with the investment.

Brealey and Myers (1992, p. 579) developed a methodology that simplifies the effort of valuing a call option using the Black-Scholes model. This methodology follows four steps:

1st step: a) let σ^2 be the variance of returns per unit of time in our project; b) multiply variance per period by the number of periods t to get *cumulative variance* $s^2 t$; c) take the square root of cumulative variance to change units, expressing the metric as standard deviation rather than variance. Luehrman (1998, p. 54) called this result *cumulative volatility* ($s \sqrt{t}$).

2nd step: calculate the ratio asset value to the present value of the option's exercise price. Assuming that the option's exercise occurs in t periods, the current value of the exercise price is equal to $PV(X) = X \div (1 + rf)^{t}$ and the desired quotient: $S \div PV(X)$.

3rd step: the option's value in function of the value of the exercise can be obtained by entering the values obtained in steps 1 and 2, above, in table 6 – *Call Option Values, percent of share prices* – presented in the appendix of the book *Principles of Enterprise Finances* (Brealey, Myers, 1992).

The value of a European put option value (kept until its expiration date) can be calculated using the following equality:

Value of put option + price of the asset = value of the call option + present value of the exercise price (X).

Using the Black-Scholes model's formula, it is possible to verify the impact of the variation of each variable on the value of a call option. Table 1 shows the impact for each variable:

Table 1: Impact of the Variation of a Variable onto the Value of a Call Option and a Put Option

Increasing	**Option Value**	
	Call	Put
Asset Price	↑	↓
Exercise price	↓	↑
Time to Expiration	↑	↑
Risk-free rate of return	↑	↑
Variance of Returns on Asset	↑	↓
Dividends	↓	↑

2.5.5. Relationship Between the Binomial and the Black-Scholes Methods

The results produced by binomial method approaches to the ones of Black-Scholes model when the time interval between a period and the following one is very short as the number of branches in binomial tree becomes large (Weston and Copeland, 1992, p. 454).

Figure 2 shows the evolution of an option value using the binomial model and the Black-Scholes Model. The input data in this example are: asset present value - \$100; exercise price - \$250; time to expiration - 7 years; risk-free rate of return - 10%; standard returns on asset - 40,55% and a changeable number of steps.

In the calculation of the option values we used the following tools: a) for the binomial method: *Peter Hoadley's Options Strategy Analysis Tools: Binomial Tree Option Calculator* (http://www.hoadley.net/options/binomialtree.aspx?tree=B); b) for the Black-Scholes method: *Numa Option Calculator* (http://www.numa.com/derivs/ref/calculat/option/calc-opa.htm).

In the construction of the graph we used a maximum of 150 steps. This number is due to limitations imposed by the calculators used. We used Microsoft Excel to adjust a logarithmic curve to points obtained from the calculators.

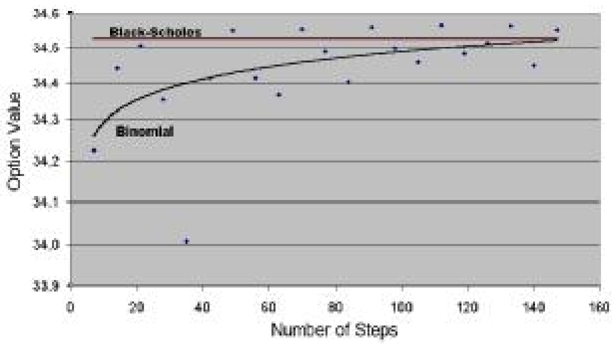

Figure 2: Relationship Between Binomial and Black-Scholes Method

2.5.6. Types of Real Options

There are eight common categories of real options (Trigeorgis, 1996, p. 2):

1. Option to defer – enables the management to defer investment for a project or one of its stages. This option can be expressed as an American call option on the gross present value of the completed project's expected operating cash flows with an exercise price equal to the required outlay.

2. Option to expand – enables the management to increase operation capacity if market conditions turn out more favorable. This option can be expressed as a call option to acquire an additional part of the base-scale project, paying an additional expansion cost as exercise price.

3. Option to contract – enables the management to operate below capacity or even reduce the scale of operations thereby saving part of the planned investment outlay. This option can be expressed as a put option where the asset price is represented by the percentage of the basic project equivalent to the reduction, being the exercise price equal to the potential saving.

4. Option to shut down and restart operations – enables the management to shut down installations if cash revenues are not sufficient to cover variable operating costs. If prices rise sufficiently, operations can be restarted. This option can be expressed as a call option to acquire that year's cash revenue and the exercise price equal to the variable cost of operating.

5. Option to abandon – enables the management to abandon the project permanently in exchange for its salvage value. This option is similar to an American put

option on the project's current value with an exercise price equal to the salvage or a best value alternative, such as selling the project to another company.

6. Option to switch – enables the management to switch from one way of operation to another, such as adopting a flexible process that allows for different technologies. It can be represented by a portfolio of options that consists of both call and put options.

7. Growth option – sets the path of future opportunities of strategic importance for the company. It can be represented by composed options where each new business opportunity is a contingent option to the previous exercise of other options.

8. Multiple interacting options – involve a collection of various options. Upward-potential-enhancing and downward-protection options are present in combination. They can be represented by composed options.

3. A Generic Model for B2b Companies

Figure 3 presents the "B2B Global Model", a generic model proposed for the B2B environment. Components of this model can be virtual companies (pure-play dot-com), mixed companies (bricks and clicks) or, in some cases, traditional companies (bricks and mortar).

In operational terms, the B2B Company presented in the generic model offers suppliers and consumers a virtual place where they can perform transactions in an easy and safe way. The technological solutions and tools offered by the B2B Company reduce the total costs and a make the transactions between suppliers and consumers more efficient. The B2B Company offers several kinds of services such as: collaborative planning, forecasting and replenishment, catalogue of products and the implementation of supply chains.

The representation of the B2B Company makes explicit the sectors in charge of Technology, Marketing, Law and Payment because of their importance to the company and its relationship with the external elements interacting with it. Such sectors have a strong integration among one another. For example: the Technological area provides support to Marketing by means of CRM tools; the Legal area provides support to the Payment area by modeling the agreements made among the diverse elements that compose the Company's internal and external environment.

To carry their transactions in the B2B environment, the companies need external support from other companies, especially those related to the areas of technology, marketing, law and payment. These companies are represented in the model by the name of e-Technology, e-Marketing, e-Law and e-Payment, respectively. Other companies that do not belong to these groups are called e-Others. These companies can be virtual companies, traditional companies or mixed companies (bricks and clicks).

Governmental institutions, market-specific entities, unions and other regulation and control institutions with which companies in the B2B environment relate are also represented in our model by e-Laws.

There are several particular cases of B2B models which are subsets of the generic model presented here, such as: (a) purchases made to Suppliers effected by a single Buyer, such as Wal Mart Stores (www.walmartstores.com); (b) sales performed by a single Supplier, such as Ford do Brasil (www.ford.com.br), which sells parts to their distributors exclusively through the Internet; or (c) company that are service providers, such as an ASP provider.

Below, the nomenclature referring to the components in the model, as presented in Figure 3, is described:

- **Co_k** – B2B Company k – k^{th} electronic-commerce solution provider, connecting Suppliers and Consumers in a virtual environment and providing Client services.
- **Su_i** – Supplier i – i^{th} goods and/or service provider.
- **$Co(k, Su_i)$** – relationship between the k^{th} B2B Company and the i^{th} Supplier. The same Supplier can appear in the model associated to other companies.
- **Cs_i** – Consumer i – i^{th} goods and/or service consumer.
- **$Co(k, Cs_i)$** – relationship between the k^{th} B2B Company and the i^{th} Consumer. The same Consumer can appear in the model associated to other companies.
- **Cl_i** – Client i – i^{th} client.
- **$Co(k, Cl_i)$** – relationship between the k^{th} B2B Company and the i^{th} client. The same Client can appear associated to other companies.
- **Te_j** – e-Technology j – j^{th} technology-solution provider.
- **$Te(j, Co(k, Cl_i))$** – support provided by the j^{th} technology-solution provider to the i^{th} client in its relationship with the k^{th} B2B Company. The same Client can be supported by the same technology-solution provider in its relationship with other companies.
- **Ma_j** – e-Marketing j – j^{th} marketing-solution provider.
- **$Ma(j, Co(k, Cl_i))$** – support provided by the j^{th} marketing-solution provider to the i^{th} client in its relationship with the k^{th} B2B Company.
- **La_j** – e-Law j – j^{th} legal-solution provider or regulatory agent.
- **$La(j, Co(k, Cl_i))$** – support provided by the j^{th} legal-solution provider or control made by the regulatory agent on the i^{th} client in its relationship with the k^{th} B2B Company.
- **Pa_j** – e-Payment j – j^{th} financial institution.

- **Pa (j, Co (k, Cl $_i$))** – relationship between the j[th] financial institution and the i[th] client in its relationship with the k[th] B2B Company.

- **Ot $_j$** – e-Other j – j[th] provider of other services. An example of a company in this class could be a recruiting company of specialized personnel.

- **Ot (j, Co (k, Cl $_i$))** – support provided by the j[th] provider of other solutions to the i[th] client in its relationship with the k[th] B2B Company.

- **Pr (Co $_i$, Co $_j$)** – e-Partnership – joint efforts between the i[th] B2B Company and the j[th] B2B Company sharing functions and expertise in order to provide their Clients excellence in technology and services.

- **SC (Co (k, Su $_i$) , Co (k, Cl $_j$))** – Supply Chain – supply chain connecting Supplier i to Consumer j in its relationship intermediated by B2B Company k.

4. Evaluating B2b Companies

The value of a B2B Company is equal to its value without managerial flexibility added by the value of its internal and external real options. The value of the company without managerial flexibility can be obtained using the traditional net present value.

Internal options are those inherent to managerial flexibility that only affect the company. Below there are some examples of internal real options:

- Option to expand – possibility of a B2B Company to expand its transactions with suppliers and consumers in case it has extra capacity or, conversely, to invest if it is economically feasible.
- Option to defer – alternative to postpone a new internal project or one of the stages of a project of the company.
- Option to contract – possibility to reduce its performance in the market, if one of its segments is not profitable.
- Option to shut down and restart operations – alternative to cancel one ore more activities of the company for a certain period of time until the conditions of the market become more attractive to the company.
- Option to abandon – alternative to abandon the project permanently or permanently close the activities of the company.
- Option to shift – possibility to change the kind of activities in the market.

External options are those related to other companies, that is, suppliers, consumers, clients, solution providers, partnerships, Governmental institutions, unions and others, such as:

- Option to switch – alternative to change the technology used affecting the relationship with other companies.
- Option to expand – the partnership with an international law office can assure the extension of legal support to the Company in new geographic regions, minimizing costs and speeding up the presence of the company in new regions.
- Option to contract – the reduction of profits of certain segment of a company can force it to lock up its activities with a certain group of companies, harming them in some way. The existence of an option to contract will give the right to the company to lock up these activities without suffering any legal constraint.

We could mention many other examples of real options, but the ones presented clearly demonstrate the value of these options and how they affect the value of a company.

Using the components of the "B2B Global Model" in figure 3, we can identify the existing real options and calculate their respective values. Representing by NPV the net present value, ROV the real option value, Co_k the evaluated company and by *Modified* NPV the total value of the $Company_k$, then the total value of $Company_k$ can be expressed by:

Modified NPV (Co_j) = NPV (Co_j) + (NPV without managerial flexibility)
Σ *internal* ROV + (Total value of internal real options)
Σ *external* ROV (Total value of external real options)

where

Σ *external* ROV = $\sum_{i=1..n}$ ROV (*Co* (*j*, *Su* $_i$)) + *(Total value of supplier options)*
$\sum_{i=1..m}$ ROV (*Co* (*j*, *Cs* $_i$)) + *(Total value of consumer options)*
$\sum_{i=1..p}$ ROV (*Co* (*j*, *Cl* $_i$)) + *(Total value of client options)*
$\sum_{i=1..o}$ ROV (*Co* (*j*, *Te* $_i$)) + *(Total value of technology provider option)*
$\sum_{i=1..n}\sum_{k=1..r}$ ROV(*Te* (*k*,*Co* (*j*, *Su* $_i$)) +
$\sum_{i=1..m}\sum_{k=1..r}$ ROV(*Te* (*k*,*Co* (*j*, *Cs* $_i$)) +
$\sum_{i=1..p}\sum_{k=1..r}$ ROV(*Te* (*k*,*Co* (*j*, *Cl* $_i$)) +
$\sum_{i=1..q}$ ROV (*Co* (*j*, *Ma* $_i$)) + (Total value of marketing provider options)
$\sum_{i=1..n}\sum_{k=1..q}$ ROV(*Ma*(*k*,*Co* (*j*, *Su* $_i$)) +
$\sum_{i=1..m}\sum_{k=1..q}$ ROV(*Ma*(*k*,*Co* (*j*, *Cs* $_i$)) +
$\sum_{i=1..p}\sum_{k=1..q}$ ROV(*Ma*(*k*,*Co* (*j*, *Cl* $_i$)) +

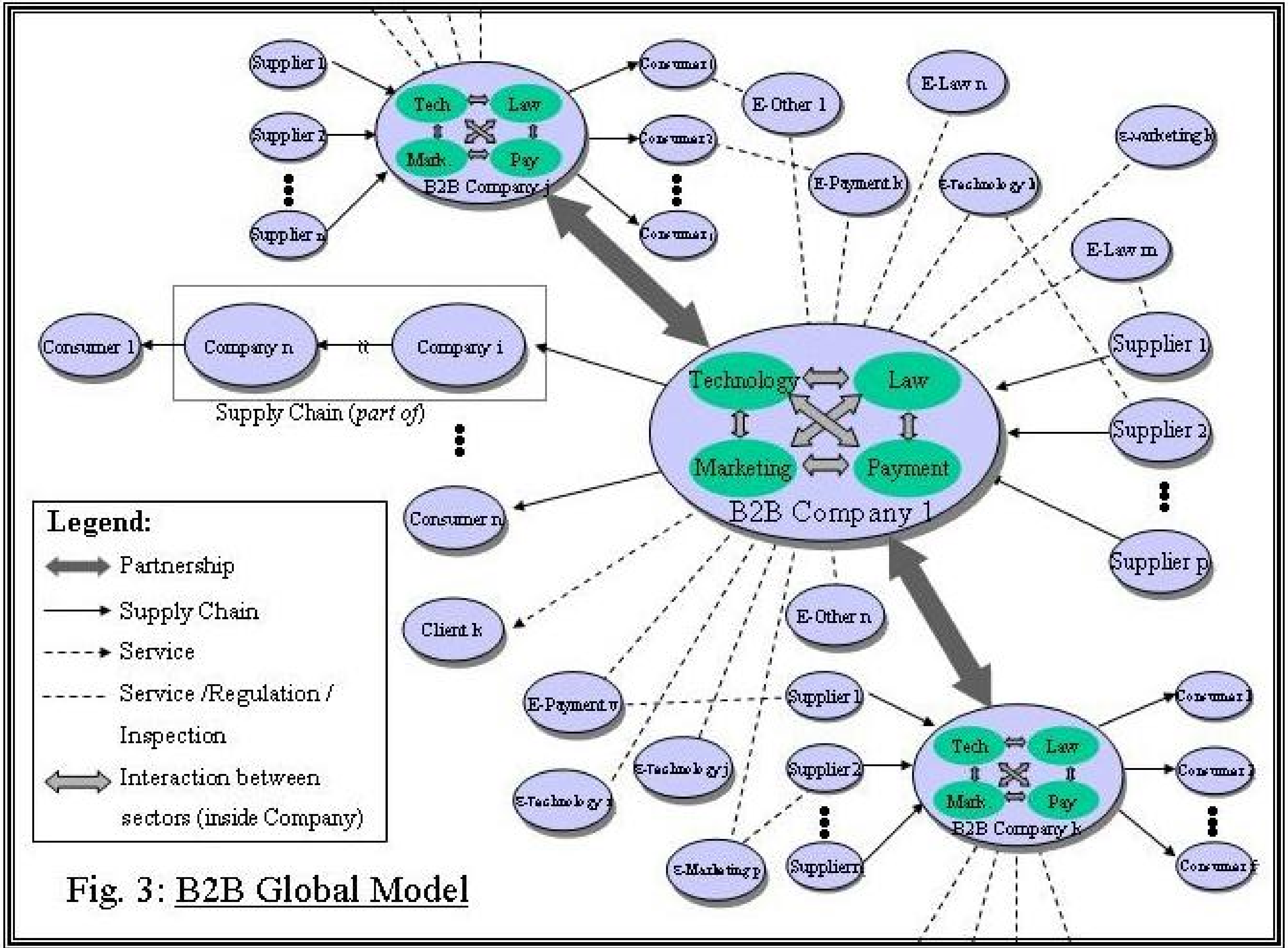

Fig. 3: B2B Global Model

$$\sum_{i=1..q} ROV(Co(j, La_i)) + \quad \text{(Total value of law provider options)}$$
$$\sum_{i=1..n}\sum_{k=1..q} ROV(La(k, Co(j, Su_i)) +$$
$$\sum_{i=1..m}\sum_{k=1..q} ROV(La(k, Co(j, Cs_i)) +$$
$$\sum_{i=1..p}\sum_{k=1..q} ROV(La(k, Co(j, Cl_i)) +$$

$$\sum_{i=1..r} ROV(Co(j, Pa_i)) + \quad \text{(Total value of payment provider options)}$$
$$\sum_{i=1..n}\sum_{k=1..r} ROV(Pa(k, Co(j, Su_i)) +$$
$$\sum_{i=1..m}\sum_{k=1..r} ROV(Pa(k, Co(j, Cs_i)) +$$
$$\sum_{i=1..p}\sum_{k=1..r} ROV(Pa(k, Co(j, Cl_i)) +$$
$$\sum_{i=1..s} ROV(Co(j, Ot_i)) + \quad \text{(Total value of other provider options)}$$
$$\sum_{i=1..n}\sum_{k=1..s} ROV(Ot(k,Co(j, Su_i)) +$$
$$\sum_{i=1..m}\sum_{k=1..s} ROV(Ot(k,Co(j, Cs_i)) +$$
$$\sum_{i=1..p}\sum_{k=1..s} ROV(Ot(k,Co(j, Cl_i)) +$$
$$\sum_{i=1..t} ROV(Pr(Co_i, Co_j)) + \quad \text{(Total value of partner options)}$$
$$\sum_{i=1..m}\sum_{k=1..n} ROV(Sc(Co(j, Cs_i), Co(j, Su_i))) \quad \text{(Total value of existing options in supply chain)}$$

The list of real options presented above is theoretical, because it would be very expensive and it would take too much time to identify and obtain all the values of these options. In practice, we need to select the more valuable real options and work with those that are feasible to be exercised. Furthermore, interactions among real options present in combination generally make their individual values non-additive. The nature of such interactions and the conditions under which they may be small or large, as well negative or positive, may not be trivial.

5. Conclusion

This work has brought new contributions to the evaluation of Business-to-Business companies. Initially, we have examined techniques presented in the literature: discounted cash flow, sensitivity analysis, simulation, decision-tree analysis and options, discussing each one's advantages and disadvantages. We have concluded that, with the exception of real options, none of them contemplates managerial flexibility.

The use of the "Global B2B Model" in the evaluation of B2B companies is an advance because it allows the identification of the types of companies that operate in this environment: suppliers, consumers, customers and others related to the areas of Technology, Marketing, Law and Payment. This identification allows us to take into account all companies with which the company being evaluated relates to.

The identification of these companies and their characteristics allows us to collect all existing internal and external options for the company being evaluated. We have shown that the calculation of the value of any one of these options is possible by establishing a correspondence between its characteristics and those of a call option or a put option and, in some cases, of a portfolio of call and put options. The methodology presented for the calculation of each option was based on the work by Luehrman (1998).

Finally, we have concluded that the calculation of the company's value can be done taking into account the net present value (without flexibility) of the company plus the total value of the internal and external real options of the company being evaluated. It is important to emphasize that in practice, due to the existence of a great number of direct relationships and partnerships with other companies, it is necessary to verify which options are more representative for the calculation of the company's value in virtue of the effort, cost and time consumed in the calculation of each option value.

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