Business Modelling with UML: the Corporate Valuation Process

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The recent crises in financial markets have helped to question the traditional concept of financial value. As a result, the corporate valuation becomes a complex process involving technical and less technical parameters. This paper proposes a process model for corporate valuation from representations of the evaluation process shared by stakeholders thereof (investors, acquirer, target, independent appraiser, financial analyst, controller ...) using the Unified Modelling Language. This model suggests actions for corporate valuation process improvement.

JEL Codes: C88, G34 and H32.

1. Introduction

Theories and practices of corporate finance have largely evolved since the 50’s adopting more normative approaches than positive approaches to explain why and how investors react to the decisions and announcements relating to business investment decisions and financing. The 2008 financial crisis has not only boosted mergers and acquisitions but has also revived among academics and financial professionals questions about the methods and process of financial valuation. Several studies have revisited the concept of value (“fair value”, a fundamental value, strategic value ...) and some valuation models of financial instruments, assets (including intangible) and the companies themselves. Several lines of research have criticized "Brownian" models for being inapplicable within abnormal fluctuation of stock prices and have revived the behavioural theories based on observation of behavioural biases of investors. A limited number of works focused on the contributions of certain theories (organizational change, games, conventions ...) to understand and reconfigure the corporate valuation process. This article proposes a model for the corporate valuation process using UML by taking into account the quantitative and qualitative parameters of the valuation, the actors involved and the new approaches likely to give a better description of the corporate valuation. This model is based on the results of two studies. The first one is a clinical study of TimeWarner-AOL merger in 2000 and then in 2006. The second study is a survey of valuation experts who are members of two French associations named DFGC and SFEV. The purpose of this paper is to propose a model for understanding the transition from the calculation of an objective value until the fixation of a price by adopting a process approach using a standard language for understanding, sharing and improving the corporate valuation process by its various stakeholders. In the next section, we review the relevant theory and research in corporate valuation and business modelling. Then we describe our methodology and the business model provided.

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We conclude with the description of the different diagrams built with the Unified Modelling Language explaining our main findings.

2. Literature Review

2.1 The Classical Theories of Firm Valuation

Damodaran (2005) proposes four evaluation approaches. The first study is the valuation by discounting future cash flows. This method connects the value of an asset to the present value of the asset’s expected future cash flows using the following formula:

\[ V = \sum_{t=1}^{n} \frac{FCF_t}{(1+k_i)^t} + \frac{TV_{n+1}}{(1+k_i)^{n+1}} - D \]

with: \( n \): explicit forecast horizon, \( k_i \): weighted average cost of capital of the firm, \( FCF_t \): free cash flow of the year \( t \), \( TV_{n+1} \): Terminal Value, \( D \): present value of debt over a year (plus the tax saving on financing costs),

\[ TV_{n+1} = \frac{FCF_{n+1}}{k_i} - g \]

with: \( FCF_{n+1} \): free cash flow due in \( n+1 \), \( g \): annual growth rate of FCF.

Other models of discounted cash flow have been designed. The latest one is the residual income model. It has been studied by several authors: Edwards-Bell-Ohlson, Ohlson, Ohlson-Juettner etc. This is why, it is known as EBO: Edwards, Bell and Ohlson, based on the concept of residual income developed by Edwards and Bell (1961) and Ohlson (1991, 1995).

The second approach is the balance sheet-based method. It is built around the valuation by evaluating the various assets, divisions or subsidiaries of the company with the accounting estimates of the value or book value. This model is often used as a starting point.

Thirdly, in the absence of share prices, methods of assessment called "comparable" and "multiple" are generally applied (Rerolle, 1996). They determine the fundamental value of a firm, either directly from the prices of recent transactions of a sample of firms working in a similar or comparable field of action, or indirectly, from the benchmarks (indicators of value) and/or markers (indicators of performance) of these companies. The validity of the method depends on the comparability of businesses, organizations and business performance, and requires market transparency.

Finally, the real options valuation method uses models of option pricing to measure the value of assets that share option characteristics (Trigeorgis, 1996). This method, being derived from the famous model of Black and Scholes (1973) and Cox and Ross (1979) applicable to financial options, aims to evaluate the firms as an options portfolio more or less risky. The value of the option is an increasing function of the option validity duration and the project earnings volatility.

2.2 The New Theoretical Framework of Corporate Valuation

In practice, these models are applied differently. Barker (1999) provides a review of valuation models actually used by investors and financial analysts. He notices that "the PE ratio (market capitalization on equity) is of a paramount importance" and that "the DCF model, the technical analysis and the beta analysis are not used in investment decisions". In a survey of analysts and fund managers, he notices that the PE model and the dividend yield are preferred over those of DCF and discounted dividends. These observations confirm those of Arnold and Moizer (1984) in U.K., Pike et al. (1993) in Germany and Block (1999) in U.S.A. Besides, Copeland et al. (2000), Palepu et al. (2000), Penman (2001) and Demirakos et al. (2002) favour the multi-period models based on DCF. Palepu et al. (2000) note that the use of the DCF and the EVA-MVA methods lead to identical values, and the choice of the method depends on other parameters, often, linked with stakeholders’ preferences. Therefore, this paper provides a process approach to analyze the valuation. It aims at completing this quantitative approach and determining how the transactional value is determined from this fundamental value. It proposes a new theoretical framework to study the corporate valuation.

The organizational theory: Perrow (1967) is the first to study the conceptualization process of organizational data. He distinguished between formal research-based models and investigations based on experience or intuition. Mintzberg (1971) defines an organizational process as a sequence of tasks performed for the design, production and/or distribution of a product or a service. The process includes a cycle of activities consisted of a set of completed elementary operations. The process management aims to place it under control and/or increase its productivity. Argyris and Schon (1978) assimilate organizational processes to loops or chains of interaction between the involved actors which are guided by standards and rules allowing the process to adapt. Davenport (1992) than Hammer and Champy (1993) propose to reconfigure business processes using operational research methods and information technology and communication tools. In the field of organizational finance, the organization of the corporate valuation process concerns financial Engineering. According to these authors, this process has a variable number of steps. Copeland et al. (1990) identify five main steps: strategic, organizational and financial diagnosis of the target firm, audit of contracts and accounts, the response to the tender, negotiation of the price transaction, the transaction’s setup, and the implementation of legal, administration and finance operations. Pene (1984), Tchéminé (1993) and Chapelle (2002) focus on the iterative nature of the approach and distinguish an exploration phase (dedicated to the diagnosis and evaluation) and an operational phase (dedicated to the negotiation and the implementation of the operation). Damodaran (2005) divides operations into three phases: scooping the fundamental value of the target company, estimating its strategic value, negotiating the transaction value (or price).

The strategic approach: here, investors have to analyze the strategic intentions and rational expectations of disinvestors, and vice versa, to estimate the strategic value (or limit value) at which they are willing to sell (or buy) the shares of the target company. The strategic approach is also interested in simulating the behaviour of actors in the corporate valuation process, in accordance with the games theory. Schwager (1996), Gresham (1998) and Godechot (2001) study the perceptual and cognitive biases recurring (overconfidence, over-reaction to signals ...) that affect the
behaviour of traders. Schiller (2000) analyzes the mental representations that affect market traders and analysts.

The constructionist theories: they attempt to go beyond the paradigm of methodological individualism underlying in the previous approaches. They particularly argue that the embedding in a socio-professional network (Granovetter, 1985) contributes to enrich the resources devoted to commercial exchange. This "social construction of markets" (Berger and Luckman, 1967) implies an analysis of strategies and behaviours of different groups of actors (functional teams, project groups, communities of practice...) which are directly or indirectly involved in the exchange. This approach relies on the knowledge of share logic and representations of the environment specific to stakeholders in a process, and on the types of strong and weak links between them (Huault, 2004). The process of creating and measuring the value represents a part of a corporate governance process (Hirigoyen and Caby, 2005).

The theory of conventions: the axioms of social networks are inseparable from this theory. It is inspired by Popper and conceptualized by Favereau (1989), Gomez (1989) and Orlean (1994). "A convention is a collective cognitive device - a common benchmark - enabling an operator, facing a situation where neither rational calculation nor the establishment of a contract does determine the action, however, to choose an appropriate behaviour" (Montmorillon, 1999). The issue raised by the incompleteness of markets, refers to the mode of coordination of collective action, to the conditions of decision making and decision enforcement and to their institutional framework and social rooting. The conventionalist model seeks to define a coherent set of principles explaining the actions of managers. It postulates the existence of agreements which construction may involve various techniques (such as game theory or operational research) to better analyze and frame the action-reaction process of the operators. Uncertainty about their intentions and their behaviour makes it difficult to determine ex ante contract terms. These theories are testing the applicability of their concepts on many management situations but they incidentally evoke the issue of corporate valuation. Though it has the dimensions of an agreement, players are faced with limbo, conforming to conventions (in the form of heuristics, models, practices...) and adapting their choice (data, models, negotiation tactics...), according to these conventions.

2.3 The Business Modelling in the Corporate Valuation Environment

In the line of thought of Pidd (1996) in business administration, modelling is an operation enabling us to establish models of a complex organizational system, including both its internal and external contexts. The aim of this approach is to study this system more easily and to measure the effects of a particular component variation on it. In this considering, a model is a partial representation of reality made according to the perspective of an observer who aims at understanding and changing this reality.

According to Plexousakis and Koubarakis (2001), a business model is the description of the main components, objectives, processes and so on of an organization and how they are related to each other. It is essentially the representation (on paper or computer) of the knowledge of the organization itself or what it hopes to become. Here "organization" can mean everything from a large company or government to a small team or one-person company. These definitions
support our choice to model the corporate valuation process in order to create an architecture grouping all components of this process identified through the case study of Time Warner-Aol merger and the experts’ survey. As shown by Penker and Eriksson (2000), the models facilitate the comprehension and the communication of complex systems, but only when the objective of the model is well defined. The aim of our model is to help valuators to understand and improve the corporate value construction process. We propose the use of UML, a semi-formal language that is based on object-oriented modelling. The object-oriented methods allow process modelling by focusing on the objects that compose the process. The growing interest of this approach is the use of domain objects and not the features. This guarantees a better evolution of the system. The valuation can be described in terms of processes that achieve objectives by working with different types of resource objects. The rules specify the conditions and constraints to show how these processes and resources can combine one another and how they behave. This can be modelled on objects, relationships between these objects and the interactions between objects. Using a standard notation such as UML, means that the tools are already there, and that the same tools that are used to model information systems can be adapted and used to describe the business like the corporate valuation process. This allows automatic switching to computer programming which facilitates the automation of certain parts of this process (execution of valuation methods, building forecasted data...). This is a solution that we intend to propose as a track to improve the valuation process. A standard notation also facilitates communication between different teams or companies, or actors that have to cooperate as stakeholders of this process.

3. The Methodology and Model

Reminder interventions by the two investigators were mainly aimed to seek clarification of terminology, answers justifications and explanations. Each face-to-face interview lasted between 35 and 50 minutes. Some respondents sent after the interview additional answers by email. Data processing has been quantitative and qualitative (discourse analysis) using NVivo software. These results were represented by a model using UML.

3.1 Unified Modelling Language

UML (Unified Modelling Language) (Evans et al. 1998) became the design standard for software development. In 1994, UML has been developed by Rumbaugh and Booch (joined later by Jacobson in 1995). UML allows different views to represent a process, it provides an extension mechanism to allow the extension of the notion and it uses Object Constraint Language (OCL) in order to facilitate the verification of the model.

UML is a modelling language that can be used for modelling business, or enterprise modelling as well as software engineering. It is a language that can be expanded and configured (Eriksson and Penker, 2000). Our model is based on Eriksson-Penker: Business Extensions for UML. These allow the use of UML even when the business modelling is complex and difficult, as is the case for the corporate valuation process. They provide symbols for modelling processes, resources, rules, objectives and actors of a business system. This means that they allow modelling quantitative and qualitative objects, a very important point matching with the reality of the corporate valuation process.
Table 1: Summary of UML notation used in this paper

<table>
<thead>
<tr>
<th>Notation</th>
<th>Name</th>
<th>UML definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Business Process or sub-process" /></td>
<td>Business Process or sub-process</td>
<td>A process takes input resources from its left-hand side and indicates its output resources on its right-hand side (shown as dependencies to and from the process, according to standard UML syntax). The Name is a textual description of the process.</td>
</tr>
<tr>
<td><img src="image" alt="Business object" /></td>
<td>Business object</td>
<td>An object which is input to or output from an object. A stereotype may be added to clarify, for example to reflect process goals &lt;&lt;goal&gt;&gt;, physical resource, &lt;&lt;resource&gt;&gt;, information, &lt;&lt;information&gt;&gt; or people &lt;&lt;people&gt;&gt;, ... The Name is a textual description of the object.</td>
</tr>
<tr>
<td><img src="image" alt="Dependency" /></td>
<td>Dependency</td>
<td>Connecting line with arrow shows dependencies between model components. Direction of arrow indicates direction of dependency. This also can be annotated with a stereotype to clarify the nature of dependency.</td>
</tr>
<tr>
<td><img src="image" alt="Package" /></td>
<td>Package</td>
<td>It is a namespace that can contain elements of a model, diagrams or other packages.</td>
</tr>
<tr>
<td><img src="image" alt="LOOP" /></td>
<td>LOOP</td>
<td>It allows modelling iterative process according to a number of hypotheses (Y)</td>
</tr>
</tbody>
</table>

4. The Findings

The case study of the Time Warner-AOL merger and the survey of experts help us to identify the stages of this process, which is found most often in the various valuation processes, as indicated by the majority of experts surveyed. We were able to collect a lot of information that allows us to best describe the sequence of these steps.

This global process is represented by the following UML diagram using Enterprise Architect software:
The acquirer begins his valuation process by choosing a target. This stage must be carried out carefully to guarantee the success of the operation (M&A, cession...). At this time, the target valuation process begins. In order to calculate the target’s fundamental value, both parties have to choose a valuation method, to determine the forecasted data and all other parameters required to execute financial methods. The next step concerns the adjustment of the fundamental value after valuing the potential synergy gains made by each party. The third package concerns the determination of the transactional value by confrontation of the two parties.
Figure 2: Acquirer's process
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Figure 3: Target's process
4.1 Presentation of the Main Sub-Processes

Now, we will present the principal sub-processes in both packages.

4.1.1 The Sub-Process of the Target Choice

We propose to use a multicriteria decision aid method named PROMETHEE to improve this stage. This method provides a comparison approach based on quantitative and qualitative criteria using a scientific and rigorous approach. That's why we think it would be appropriate to solve the problem of target selection. The multicriteria decision aid methods have the originality to take into account several criteria at the same time, qualitative and quantitative but in a scientific and rigorous way.

The steps for the implementation of this method are:

**Step1**: identifying a first selection of companies.
**Step2**: determining the valuation criteria list.
**Step3**: determining the criteria weights.
**Step4**: valuing each company according to each criterion
**Step5**: determining the other parameters required by PROMETHEE
**Step6**: implementation of PROMETHEE
**Step7**: sensitivity analysis

The diagram obtained is as follows:

**Figure 4: The target choice diagram**
4.1.2 Fundamental Value Calculation Sub-Process:

Our study focuses on how stakeholders choose the methods to be applied in a constructivist logic involving the teams of each party. In this kind of choice, our study allowed us to conclude that the stakeholders’ subjectivity and the conventions formed in the various social groups play a key role to explain this choice. Eriksson and Penker diagram allow us to represent these non-financial parameters giving a better explanation of the corporate valuation. This sub-process is iterative and aims to generate scenario according to stakeholders’ assumption related to their preferences and the potential opportunities. LOOP function makes possible to model this.

Figure 5: Fundamental value sub-process
4.1.3 Strategic Value Calculation Sub-Process

This stage is characterized by the future synergies valuation to adjust the fundamental value calculated previously. The goal is to take into account the strategic opportunities of the operation. In this stage, each party must analyze the strategic intentions and rational expectations of the other party, in order to estimate the strategic value (or limit value) at which they are willing to sell (or buy) the shares of the target company.

This simulation should allow the two parties to adjust the fundamental value, with premiums and discounts.
Table 2: Premiums and discounts mentioned by asked panel

<table>
<thead>
<tr>
<th>Estimated Gain and Loss</th>
<th>Type of Possible Premiums or Discounts</th>
<th>Number of Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial synergies (economy of scale, integration gains)</td>
<td>Control premium</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Size discount</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Illiquidity discount</td>
<td></td>
</tr>
<tr>
<td>Financial synergies or pooling (management of financial resources)</td>
<td>Control premium</td>
<td>15</td>
</tr>
<tr>
<td>Market power (Customer attraction, rival defeat, promotion of the trademark, cross marketing…)</td>
<td>Control premium</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Social premium</td>
<td></td>
</tr>
<tr>
<td>Growth drivers (collection of resources and scarce skills, stimulation of group dynamic skills, access to networks of influence…)</td>
<td>Control premium</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Premium underrun</td>
<td></td>
</tr>
<tr>
<td>Levers of control (more efficient management and leadership)</td>
<td>Control premium</td>
<td>8</td>
</tr>
<tr>
<td>Restructuring costs (transfer of loss-making activities, social plans, integration systems, resistance to change…)</td>
<td>Conglomerate discount</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Sectoral/climate discount</td>
<td></td>
</tr>
<tr>
<td>Shares without voting right</td>
<td>Minority discount</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Discount of lack of voting</td>
<td></td>
</tr>
</tbody>
</table>

4.1.4 Transaction Value Sub-Process

This stage is very important because it is the purpose of this process since its issue is the final value or price. This stage is characterized by the involvement of all stakeholders in the process, specifically investors and disinvestors (acquirer and target) who will be negotiating this value using their ranges of values obtained at the end of their individual valuation process.
5. Summary and Conclusions

This article seeks to contribute to the understanding of the corporate valuation process and its impact on decisions to be taken during a financial engineering operation.

The UML modelling has given a top view of a complex system, which includes several components of different kinds: actors (managers, appraisers, banks ...), financial information (cash flow, share price, ...), organizational data (strategic diagnosis ...), inter-subjective approaches (convention theory, constructionist paradigm, multicriteria decision aid, game theory...).

This is why, this research has the merit of proposing a new approach to study and complete the corporate valuation process because it includes all the components mentioned above.

UML can be used to improve certain stages of the valuation process. The diagram made in this paper is ideally suited to detect any problems and thus take action for improvement. Our model suggested some ways to increase the efficiency of this process.

First, PROMETHEE multicriteria method enables the realization of a rigorous and realistic choice by including quantitative and qualitative criteria. Therefore, the preferences of decision makers responsible for the cognitive biases in the evaluation process are taken into account but in a scientific way.
This representation of valuation reality is a first layer of the overall valuation process architecture. The interest would be to use it and improve it to create other diagrams for the best use of the objects in this diagram.

We believe that, as next steps of modelling, we can use the paper's diagram to create a collaborative platform between the various stakeholders and may also result in a deployment diagram or some sub-processes can be linked to such tools or software available in the market.

References

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Appendix

Figure 2:
Figure 3: