Communications of the IIMA

Volume 8 | Issue 3 Article 6

2008

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A.J. Gilbert Silvius

Utrecht University of Applied Sciences Netherlands

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A. J. Gilbert Silvius
Utrecht University of Applied Sciences
Netherlands
gilbert.silvius@hu.nl

ABSTRACT

The relation between IT and value is a complex and disputed one. Many studies are not decisive in their results. This paper presents an overview of approaches to the 'quest for value' and identifies the qualities of and issues with each approach. It adds several new insights, including what's missing from most approaches: taking into account the nature of the investment. From this notion a conceptual model to select the most appropriate valuation approach is developed.

INTRODUCTION

The business value of information technology (IT) is a topic that is cause for a lot of discussion (Stewart et al., 2007). Skepticism roars again in the boardrooms of many companies, as the e-business hype exploded in the face of many 'believers' of the new-economy gospel. Without strong technological developments to thrive upon and an uncertain economic perspective the pressure on IT budgets is high. For investments in IT the requirement of sufficient returns and a clear 'business case' is even more severe than before. Several surveys indicate that the issue of measuring benefits of IT investments is a concern in many organizations (Whitling et. al., 1996). Measuring IT benefits and value is frequently reported as one of the most important issues for senior IT management (Brancheau & Wetherbe, 1987; Niederman, Brancheau & Wetherbe, 1991).

Based on these notion, researchers and practitioners have created numerous models and valuation methods to capture this value (Frisk, 2007). Without claiming to be complete, Renkema en Berghout (1996) listed over 50 methods, and many more have been added since than. Nijland (2004) however concluded that more advanced methods are hardly used. Managers only use methods they intuitively understand. So where science is developing more sophisticated instruments, is practice turning its back to it. What is missing that causes this mismatch?

This paper aims to add to the understanding of valuation methods by providing a comprehensive selection model for selecting the valuation method that fits the characteristics of the investment.

Hereto we will provide a categorized overview of valuation method and discuss the applicability of these methods in practice. We will than analyse how these methods can be combined in a investment selection process and identify the characteristics of an investment that determine the applicability of a certain method. We will conclude the paper by combining these characteristics in a decision tree shaped model that selects the appropriate valuation method for any given set of characteristics.

VALUATION METHODS

The valuation of investments is basically an economic issue for which it is irrelevant whether the investment is in IT or in any other resource. As long as the effects of the investment are understood, calculating the value of it is merely a financial technicality.

This sounds almost too good to be true. Indeed, it is not quite that simple. Financial valuation methods all have assumptions and limitations, which caused both practitioners and academics to develop (e)valuation methods that

consider more than just the financial aspects. After considering over 50 evaluation methods Renkema en Berghout (1996) grouped these methods into four categories: financial methods, multi-criteria methods, ratio methods and portfolio methods.

Financial methods

The group Financial evaluation methods comprises of the traditional economic investment selection and valuation methods. Table 1 provides an overview of these valuation methods and their most important qualities and limitations.

Table 1: Overview of Financial valuation methods.

Valuation method	*Qualities*	*Limitations*
Return on investment	• Easy to calculate • Easy to interpret (a simple percentage) • In line with the financial administration	• Outcome sensitive to amortization method • Ignores the time-value of money • Ignores risk
Pay-back period	• Quite easy • Intuitively coping with risk	• Ignores part of the revenues • Simplistic, does not determine value
Internal Rate of Return	• Includes the time-value of money • Easy to interpret (a simple percentage) • Based on cash-flows	• Complex • Not in line with the financial administration • Ignores risk • Multiple outcomes, or none, possible
Discounted Cash Flow / Net Present Value	• Includes the time-value of money • Based on cash-flows • Copes with risk	• Complex • Complex to interpret • Not in line with the financial administration • Not conclusive in case of projects with different durations
Economic Value Added	• Includes the opportunity value of money • In line with 'shareholder value'	• Value calculation based upon one of the other methods • Not in line with the financial administration

The shortcomings of these methods are especially clear when IT investments are made that impact the organizations market proposition. In this arena it is hard to make informed decisions when many variables are in flux. Traditional calculation methods are all limited in their ability to cope with risk and managerial flexibility. For example if a project proves to be a success, it can be sped up. If however the market deteriorates, the investment outlays of the project can be lowered or postponed. Despite the logic of this, in reality management adapts plans based on actual conditions all the time, this flexibility is not adequately valued in any of the valuation methods mentioned earlier. The result is an inadequate decision process for new projects. In some cases this even results in competitive investment proposals being rejected. Therefore it is clear that companies need to come up with new ways of judging IT investments.

Advanced financial methods

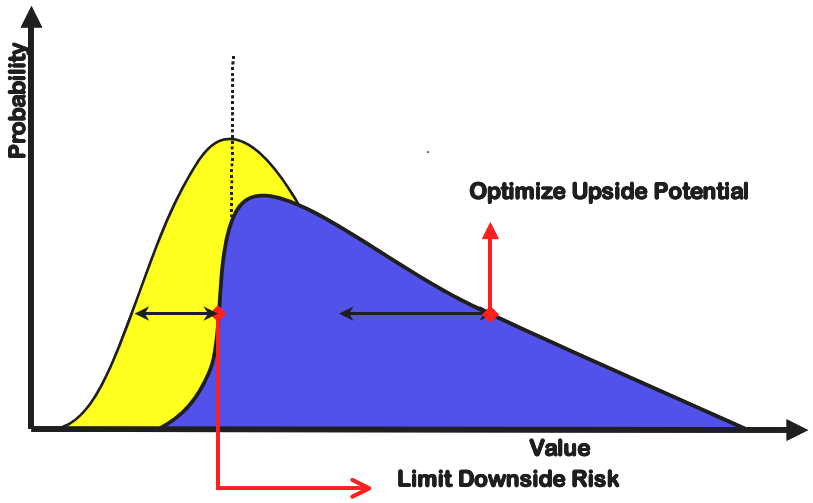
A new insight is provided by the Real Options Valuation (ROV) theory (Trigeorgis, 1996). In the ROV an additional value is calculated on top of the Net Present Value (NPV) of a project. This 'flexibility value' valuates the optionality of the investment. Optionality reflects the ability to alter the investment outlay and the timing of outlays based on changes in the competitive environment. ROV treats the possibilities of adapting the investment plan as (real) options.

The opportunity to invest can be seen as a call option, involving the right to acquire an asset for a specified price (investment outlay) in a future moment. A call option gives the holder the right, for a specified price within a given amount of time, to exercise the option to acquire the underlying asset. The techniques derived from option pricing, quantify the management's ability to adapt its future plans to capitalize on favorable investment opportunities or to respond to undesirable developments in a dynamic environment by cutting losses.

A valuable insight that can be gained from option theory is the effect of changes of the variables of the investment on the value of the investment. An interesting fact is that, for example, an increase in the volatility of the returns decreases the NPV, but increases the ROV!

Another addition to the traditional valuation methods is the notion that the returns of an investment are not only influenced by the organizations own decisions, but also by the decisions of the competition. For example the first telecom operator that implements an innovative new service will enjoy, temporary, first mover advantages that the other players will miss when they implement the same service. Combining the real options approach with game theory, taking into account competitive counteractions, closes the gap between traditional corporate finance theory and strategic planning. Management investment decisions are made with the explicit recognition that they may invite competitive reaction, which in turn impacts the value of the firm's investment opportunity. The strategic value of early commitment in such cases must be set off against the option value of waiting and may potentially justify early investment.

Figure 1: The effect of real options on value (Smit & Silvius, 2001).



A 'Grab the dollar' game (Fudenberg & Tirole, 1985), for example, is a strategic context that is often associated with IT investments. Firms obtain a negative payoff when they end up investing simultaneously. 'Grab the dollar' illustrates the situation where the current market prospects are only favourable if one of the players invests, but simultaneous investment results in a battle with an expected negative payoff. Only the first player captures the dollar (e.g., patent), but when they all enter the market, they all end up loosing the battle. A dominant firm has an advantage to win this simultaneous game.

Based on the insights provided by the real options and game theories the traditional NPV calculation can be and should be expanded to include the effects of managerial flexibility and competitive behavior. This 'Expanded NPV' can be calculated as:

Expanded NPV = NPV + Flexibility value + Strategic value

Figure 2 summarizes this more complete valuation framework (Silvius, 2006). This framework provides a better understanding of the value of IT investments.

What do these new insights mean for the calculation of the value? In theory the knowledge is available to calculate a 'complete' value according to the framework. This calculation however will be complex and hard to understand in boardrooms. It is a drawback not to be taken lightly. The tendency to fall back on simple and comprehensible calculation methods leads to systematic underestimation of the value of IT investments especially when their effects are more than just efficiency improvement. This pitfall should be well understood. Financial theory just cannot provide us with a simple and undisputed figure or percentage that expresses the complete value of an investment. It is therefore the opinion of the economist Professor Michael Brennan that 'It is better to have the approximately optimal solution to the right problem than the exact solution to the wrong problem!!!! (Actual quote on the 2000 Real Options Group conference, May 2000).

Multi-criteria methods

Multi-criteria methods are a reaction to the problems of capturing the full value of IT investments in just financial metrics. These methods aim to identify different relevant aspects of value and risk in order to enable a thorough discussion and an informed discussion (Frisk, 2007). The most important method using multiple criteria is information economics (Parker, Benson & Trainor, 1988). This method is suited for evaluating a single project as well as a portfolio of projects. It is built on a step-by-step evaluation process.

Step 1. Determine the evaluation criteria.

In this step the management of the organization determines which criteria to use in the evaluation of IT investments. One or more of the financial criteria described above will logically be included in the set, but less measurable criteria as 'strategic fit', 'competitive advantage' will be also be part of the model. Parker and Benson identify criteria in two domains: business (= demand) and IT (= supply).

Suggested criteria in the business domain are:

+ Return on Investment
+ Strategic Match
+ Competitive Advantage
+ Management Information
+ Competitive Response
-/- Organizational Risk

Suggested criteria in the IT domain are:

+ Systems Architecture
-/- Definitional Uncertainty
-/- Technical Uncertainty
-/- Infrastructure Risk

In this model the '+' criteria contribute positively to the 'value' of the investment whereas the '-/-' criteria are considered risks and contribute negatively.

Step 2. Determine the relative weights of the criteria.

The importance or 'weight' of the different criteria may not be equal. Management therefore has to decide upon a weight factor for each criteria. The weight is expressed on a scale from 0 (not important at all) to 5 (very important).

Step 3. Evaluating the different investments.

Based upon the set of criteria and weight factors each project or investment is given a score on all of the criteria. This may seem like a very arbitrary score, but Parker and Benson provide situational descriptions for each score. It is crucially important that the scores are underpinned in this more objective way in order to create acceptation for the results of the evaluation process.

Step 4. Presenting the results.

The results of the evaluation process can be presented in a graphically attractive way. The scores of the '+' criteria are totalled to a score representing the 'value' of the investment, whereas the scores of the '-/-' criteria add up to a total 'risk' score. Combining the two scores in a two-dimensional graph (Figure 3) provides management with a concise overview of the investment portfolio. Based upon their preferences regarding the risk-return relationship, priorities can be determined and investments selected.

Ratio methods

Different from the financial and multi-criteria methods are ratio methods not aimed at evaluating a specific investment or project, but at finding the 'right' level of total IT costs in an organization. This level is expressed as a ratio, e.g. IT costs / total revenue or IT costs / employee. The outcome of these ratios should be considered relative to the same ratios at competitors or for one organization in time. Lower or higher scores on these ratios than comparable organizations are not per-se right or wrong, but should give reason for investigation and discussion.

The most prominent author on ratio methods is Paul Strassmann. This former CIO of several distinguished companies developed sophisticated ratios for specific industries. Based on his research he remains sceptical about the value of IT investments. He states that "For 55% of U.S. firms the computer budget exceeds their economic value-added." and "The "right" level of spending for computers reflects the bureaucratic characteristics of a firm, not revenue or profits."(Strassmann, 1997)

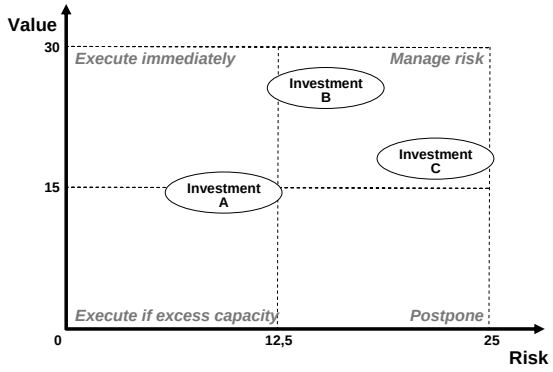
A limitation to the applicability of the ratio method however is the availability of (public) data required for the ratios.

Portfolio methods

In 1981 F. Warren McFarlan suggested to analyze and manage IT investments and projects in terms of revenues and risks using portfolio theory, as was done in the financial world (McFarlan, 1981). 'Portfolio theory' referred to the 'modern portfolio theory' as developed by Markowitz in 1952 (Markowitz, 1952). Although appealing, the use of this insight did not really take off until the Clinger-Cohen Act. This Act states that the management of IT in US government institutions '*must reflect a Portfolio Management approach …… and decisions to terminate or make additional investments are based on performance much like an investment broker is measured and rewarded based on managing risk and achieving results*'.

With it's appeal on portfolio theory, the Clinger-Cohen Act aims to bring transparency to IT costs and benefits. When applying portfolio theory to IT projects however, some issues may occur regarding the scalability of the investments, the tradability of the investments, the unique character of some investments, the exchangeability of benefits, the unfamiliarity of project risks, etc. Although the difference in characteristics between financial investments and IT investments does imply limitations to the applicability of portfolio theory, some useful insights could be derived (Van Rossum & Silvius, 2006).

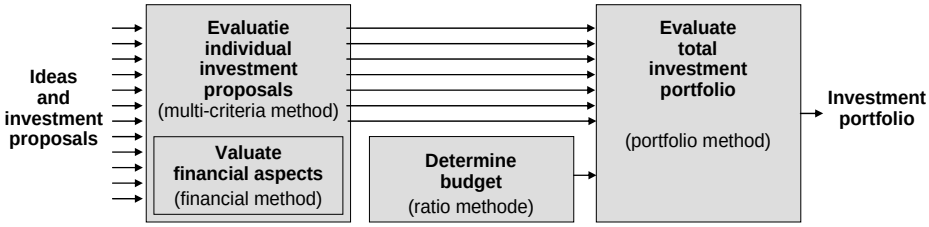
Figure 3: A typical Information Economics presentation.



An important insight in portfolio theory is the understanding that the value of an investment will be influenced by other investments or assets in the portfolio. In other words, investment decisions are not taken in isolation. Whereas all other evaluation methods study the value of an investment as an autonomous value, portfolio methods study value of investments in conjunction to other investments and assets. An insight that appeals to the common sense

when considering architectural aspects. Portfolio theory also points out the importance of having a structured process in place for the continuous evaluation of the total portfolio of IT investments and projects.

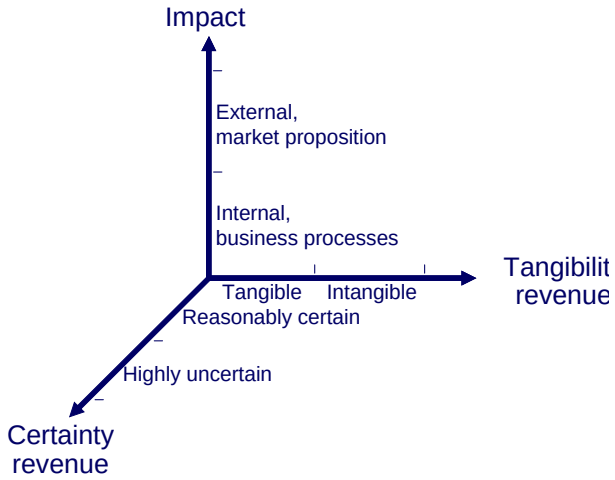
Figure 4: Combining different valuation methods in the selection process.



WHAT IS MISSING?

All methods described have their specific qualities, but also their specific assumptions and drawbacks. Based upon an understanding of these different qualities the different methods can be combined into an overall selection process to facilitate the evaluation of initiatives from idea to portfolio. Figure 4 shows this process. As a first step, ideas for IT investments are individually evaluated using a multi-criteria method that includes a financial method. The proposals that meet the criteria are than evaluated as a portfolio, in relation to all other proposals, projects and assets. In this portfolio evaluation one of the limiting factors will be the available budget. A ratio method is used to determine this budget.

Figure 5: Characteristics of the investment.

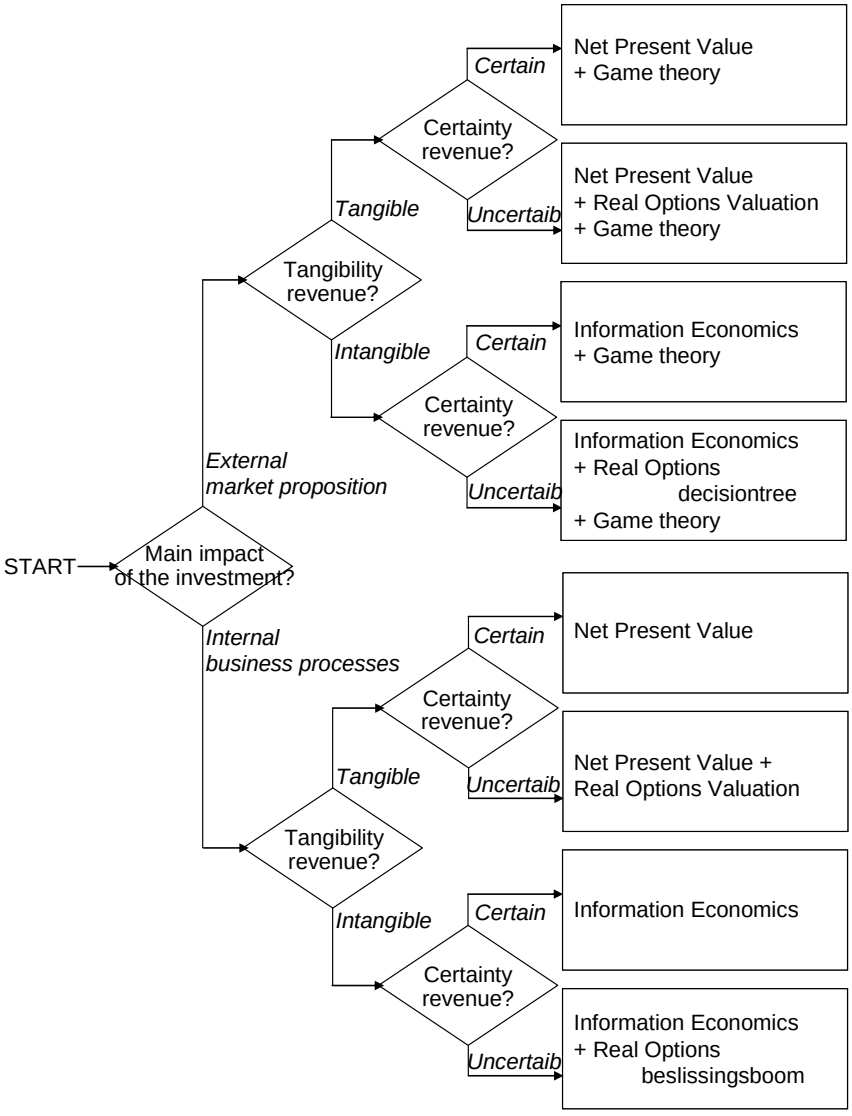


However, given the specific qualities and drawbacks of the different methods, it remains to be seen whether combining different methods in an overall process would deliver satisfactory results. In the ongoing search for 'optimal' methods however, one factor seems to be overlooked: the investment itself. IT investments, projects or assets can have many different characteristics. The criteria for selection or exclusion, and the weight of these criteria, can therefore differ as well. It could make good sense to select for example a specific investment because its risky and another investment because its safe. Or, to accept that a certain level of risk could be well acceptable for an investment in new marketing channels, but totally unacceptable for an investment in a new payroll system. Different types of investment require different considerations. Therefore, the characteristics of an investment should be added to the discussion about valuation methods.

A typical classification of characteristics could be (Figure 5):

- The impact of the investment (external market proposition vs. internal business processes);
- The tangibility of the revenue (tangible vs. intangible);
- The certainty of the revenue (certain vs. uncertain).

Figure 6: A comprehensive selection model for investment valuation methods.



A COMPREHENSIVE SELECTION MODEL

Based upon these three characteristics, a 'decision tree' shaped selection model can be constructed to select the most suited valuation method (Figure 6).

In this selection model the first choice is the main impact of the investment. Based on paragraph 5.2 it can be concluded that for investments with an impact on the market proposition, the value is influenced by the behaviour of the competition. Therefore game theory comes into the valuation. For investments with an internal impact this is not likely.

The second selection is that of the tangibility of revenues. In case of tangible revenues a financial method like Net Present Value would provide useful results, whereas in case of intangible revenues or benefits it would make more sense to use a multi-criteria approach.

A third consideration is that of the certainty of the returns. In case of higher uncertainty, the optionality of the investment grows and it would make sense to use Real Options Valuation as an additional insight.

DISCUSSION

The selection model provided in figure 6 is derived from the characteristics, strengths and weaknesses of the different investment evaluation and valuation methods. It is therefore a conceptual model that is aimed at providing guidance to practitioners in the selection of the most appropriate evaluation method. The basic point that the model makes is that evaluating IT projects and investments is not a 'one size fits all' task. The concept of an ultimate evaluation method that unveils the 'true' value is an illusion. Value is a multidimensional concept that is difficult to express in a simple number. Besides that, value is also circumstantial, depending on organizational and strategic factors and the ability to execute of the organization.

Practitioners should therefore focus their attention on understanding how an IT asset can impact business processes and/or market positioning and how this impact can be utilized fully to achieve the strategic goals of the organization. As pointed out already by Stewart et al. (2007): "*The final decision of whether to adopt an IT technology or not must be in line with the firm's strategic plan and business direction. It is only at this point that IT is likely to have a pay-off.*".

CONCLUSIONS

The value of IT is a much discussed and often misunderstood subject. This paper aims to add new understanding to the discussion by providing an overview of theoretical and practical insights. We discussed various valuation methods and showed that different methods reveal different aspects of value. However, we are still far away from a simple and easy-to-understand calculation method unveiling the complete and true value of any investment. A boardroom focus on simple Return on Investment metrics therefore should be qualified as either mismanagement or macho-talk. This opinion may not be very satisfying but it is not without grounds.

An important insight to be added is the characteristic of the investment under scrutiny. For an IT system with a mainly internal 'business efficiency' impact, the evaluation method used may be a different one than for an IT system with significant impact on the external positioning of the organization. We provided a conceptual model for the selection of the most appropriate valuation method, based on the characteristics of the investment.
As an academic challenge this selection model should be empirically tested. None of the earlier research seems to have taken into account the nature of the investment, whereas this is likely to be a factor of influence in selecting the 'right' valuation method.

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