Evaluating IT investments within corporations – real options approach

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1 Introduction

In an economic downturn many companies freeze total IT spend or mandate cost reduction programs that eliminate the initiatives on which future growth depends. This indiscriminate approach to budget cutting almost always results in higher spending down the line; IT capabilities and productivity deteriorate and IT maintenance costs rise as supporting aging applications and technologies becomes more costly.

Conversely, in the race to achieve competitive advantage during boom times, sometimes IT spending grows and is unchecked, without the discipline that value driven investment planning requires. This can prove just as costly to business performance as sweeping IT cost reduction programs.

IT investment analysis helps companies balance short and medium term investment agendas, within parameters appropriate for the economic and competitive climate. By challenging discretionary/nondiscretionary IT budget assumptions organisations can devise clear investment roadmaps which establish a very different kind of IT spending profile. The advantages of this approach are immediate: reducing wasteful or non-strategic spending releases funding for critical value-creating initiatives; preserving capabilities in the short-term and enhancing them within one to two years while the company’s IT core is strengthened.

How then choose in which IT projects or programs to invest in? There are a number of different techniques to use to evaluate and compare different options and in that way support decision making with always limited IT investment budgets. By combining sound quantitative investment evaluation with qualitative strategy alignment analysis of investments can the company, or organization, make sure that the IT functions are enabling the business capabilities of the chosen corporate strategy.

This paper focuses on different IT investment approaches and analyses the real options analysis (ROA) approach a bit more in detail and compares it to others in order to provide decision makers high level guidelines and examples for applying right ones in different situations. Therefore basic investment analysis techniques are first presented in chapter 2 (Concepts) and then different approaches presented and analyzed and compared to each other in the chapters 3 (Approaches) and 4 (Analysis). Research findings are summarized and suggestions for further research are presented in chapter 5 (Conclusions).
2 Concepts

2.1 Net present value

Projects or investments value today, net present value (NPV) is calculated by (Brealey 1991):

\[ NPV = C_o + PV, \]

Where \( C_o \) is the initial investment and \( PV \) is is the present value of the sum of cash flows the investment is going generate, i.e. discounted cash flow, DCF. The formula for calculating the present value, \( PV \) is as follows:

\[ PV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}, \]

Where \( r \) is discount factor, i.e. all cash flows are discounted at the market-determined rate of return. For publicly traded companies weighted average cost of capital, WACC, is widely used for discounting the cash flows. Sometimes the discount factor is called as a hurdle rate. Both of these concepts are defined in the chapter 2.2 Discount factor

2.2 Discount factor

2.2.1 Hurdle rate

The Hurdle rate is expressed as a percent that must be realized to make an investment worthwhile for the company. Some investments must be undertaken for reasons other than direct maximization of profits. These can be called as zero return investments. Reasons for zero return investments include complying government regulations, civic responsibilities and work quality improvements, like smokestack scrubbers, pollution control devices, or other non-revenue producing projects. For this kind of investments the hurdle rate must be set high enough to compensate for zero return investments. Evaluation of the percent of total capital outlay going into this type of project will help determine the effect of zero return on the overall investment (Accenture 2001).

An investment required to replace worn out equipment to maintain market are called replacement investments. These investments usually show a fair return on investment but may be below the current hurdle rate. In order to establish a decent hurdle rate, one has to
decide what rate of return the company is presently getting and what realistic rate it would like to earn in the future.

2.2.2 Capital asset pricing model

Capital asset pricing model is used to evaluate capital investments within corporations. The cost of money to a company, weighted average cost of capital, WACC is calculated as follows (Brealey 1991):

$$ WACC = K_d + K_e $$

where $K_d$ is the cost of debt and $K_e$ is the cost of equity. The cost of debt for a company is usually dictated by international credit institutions and the formula used remains unknown, although experienced chief financial officers tend to have a good gut feeling about it; it’s merely related to amount of debt and how strong cash flow the company has. The cost of equity is more straightforward and is calculated accordingly (Brealey 1991):

$$ K_e = r_f + \beta(r_m - r_f) $$

where $r_f$ is the risk free interest rate of an investment within that same market or area the company is operating or the company is owned by. Beta, $\beta$ is company’s stock volatility compared to markets and $r_m$ is the market return, i.e. what could be expected if one invests the capital into stock index or similar.

Management of a publicly held firm is to make decisions that maximise owners’ wealth (Brealey 1991). For example for Nokia, which is owned by U.S. pension funds, one should use the U.S. 10 year bond rate as a risk free interest rate. Usually IT investments lifecycle cannot exceed 10 years and the beta should be Nokia’s stock volatility compared to S&P 500 hundred, since those are the reference group of the investors. So by applying these assumptions one can easily determine the discount rate to be used when evaluating IT investments within any company.
2.3 Financial options

A financial option is a special stock exchange contract which gives the owner the right – but not the obligation – to buy or to sell a certain financial activity at a prefixed price. A financial option is defined by five parameters (Brealey 1991):

- Stock price - value of underlying asset today
- Time to maturity - time to expiration date
- Strike price - price to be paid to exercise the right
- Volatility - standard deviation of the underlying asset’s rate of return
- Risk free rate of return

On a high level, option valuation models can be divided into continuous and time discrete models.

2.3.1 Continuous model

Continuous model category assumes an infinite number of steps between now and future and that variations in the underlying asset follow a specified statistical distribution.

Fischer Black and Myron Scholes published their solution of option valuation of which Bob Merton comprehended to be more generalized. The breakthrough uses an entirely approach to work around the discount rate dilemma. They established the value of an option by constructing a portfolio of traded securities, known as the tracking portfolio, which has the same payoffs as the option. By the law of one price, two assets that have the same future payoffs must have the same current value.

The Black and Scholes model is continuous and rests on a number of fundamental assumptions that are (Black 1973):

- The stock pays no dividends during the option’s life
- European exercise terms are used, i.e. options can only be exercised at the specified maturity date
- Markets are efficient
- No commissions are charged
- Interest rates remain constant and known
• Returns are log-normally distributed

These assumptions imply a stochastic process with an infinite number of steps.

The Black-Scholes formula for a value of a call options present value is (See Brealey 1991):

\[ V = P N(d_1) - EXe^{-r_f t} N(d_2), \]

Where,

\[ d_1 = \frac{\log \left( \frac{P}{EX} + r_f t + \sigma^2 t / 2 \right)}{\sigma \sqrt{t}}, \]

\[ d_2 = \frac{\log \left( \frac{P}{EX} + r_f t + \sigma^2 t / 2 \right)}{\sigma \sqrt{t}}, \]

\[ N(d) = \text{cumulative normal probability density function}, \]

\[ EX = \text{exercise price of an option, i.e. strike price}, \]

\[ t = \text{time to exercise date}, \]

\[ P = \text{price of asset now}, \]

\[ \sigma^2 = \text{variance per period (continuously compounded) rate of return on the asset, and} \]

\[ r_f = \text{(continuously compounded) risk free rate of interest}. \]

2.3.2 Time discrete model

Time discrete model category assumes a finite number of steps between now and future. For each step, the value of the underlying asset can increase or decrease with certain probability. Binomial valuation is a method based on the logic of an event tree. Compared to the Black & Scholes formula, it offers the user to control more of the underlying assumptions. The option valuation model uses the no arbitrage condition to dynamically ensure that the value of the option equals the portfolio as the stock price evolves. This is known as dynamic tracking (Amram 1991).
3 Approaches

3.1 Real option analysis

Real options analysis – application of a time discrete financial option valuation model - is an attempt to quantify the value of options – a practice that today often is based on senior executives' gut feeling. When faced with (IT) investment decisions, the discounted cash flow method is probably the most widespread and commonly established method to quantify the value of an investment within corporations. However, in order to determine which project to sponsor the DCF method is often complemented with other "soft" or qualitative factors such as:

- "Investment X is more flexible"
- "Investment X builds a strategic platform"
- "Investment X gives us better future prospects"

These factors and others similar are in essence of real options analysis. Real options analysis is an attempt to incorporate the value of real options in the quantitative model when evaluating investment opportunities.

Definition: A real option is a right, but not the obligation, to acquire the present value of expected cash flows by making an investment when the opportunity is available. Applied to IT investment analysis this can be rephrased as Luehrman did in a Harward Business Review article: “a prospective IT investment is like a call option in that a company has the right, but not the obligation, to invest in the new IT solution” (Luehrman 1997).

Unfortunately companies, even the most successful ones, are just learning to make simple business cases using for example net present value calculations to choose which IT investments they are going include in their yearly IT project portfolio. Companies still lack the ability to link the additional revenues that the business capability, enabled by the IT investment, has generated.

The three common and important real options found in capital investment projects are (Brealey 1991):

- The option to make follow-on investment if the immediate investment project succeeds
• The option to abandon a project
• The option to wait (and learn) before investing

Real options such as these allow managers to add value to their firm, by acting to amplify good fortune or to mitigate loss (Brealey 1991). Term option is thought rarely used but usually managers refer to intangibles rather than puts or calls.

This option lasts for a certain period of time. If making the investment, we will capture an expected net present value, NPV, of the investment. Though, as time passes, the expected NPV of the investment changes due to the fact that the business environment changes.

Although there is some disagreement in the literature as to how to classify real options, broadly speaking, companies can exercise five option types during IT projects. The following taxonomy is one example by Martha Amram and Nalin Kulatilaka (Amram 1999):

• Timing options — Waiting for better insight into market conditions or changing demands might yield greater value than launching a project immediately.

• Exit/abandonment options — Closing down a project can increase its value because doing so limits losses.

• Growth options — An initial investment has the potential to create new opportunities that call for follow-on projects.

• Staging options — Instead of a big-bang rollout or conversion, a company rolls out a project incrementally.

• Flexibility options — Switching a project from one vendor to another, running parallel pilot projects or changing the delivery type of a solution can prove beneficial.

Real options analysis adapts mathematical models used to evaluate financial options to more-tangible investments. Semiconductor companies are starting to use this concept to make better sourcing decisions. The results can be lower costs and reduced risks in sourcing capacity (Gordon 2005).
3.2 Economic value added

Economic value added, EVA, is a performance measure directly linked to the creation of shareholder wealth over time, created by the Stern Stewart & Co. It’s purpose is to guide companies through the implementation of a complete EVA-based financial management and incentive compensation system that gives managers information - and motivation - to make decisions that will create shareholder wealth in any publicly owned or private enterprise.

The high level formula for calculating the EVA is (Stern 2006):

\[ EVA = NOPAT - (Capital - Cost \_ of \_ Capital) \]

Where NOPAT stand for net operating profit after taxes. Basically the formula is a adjusted from generally accepted accounting principles, GAAP, that is used in U.S. Stern Stewart & Co. has identified more than 160 potential adjustments in GAAP earnings and balance sheets in areas such as inventory costing, depreciation, bad debt reserves, restructuring charges, and amortization of goodwill.

While measuring EVA, companies get a better focus on how they are performing, and the EVA system covers the full range of managerial decisions, including strategic planning, allocating capital, pricing acquisitions or divestitures, setting annual goals-even day-to-day operating decisions. If the IT investment is considered to have effect on the company value, one might consider using the EVA technique for analyzing the investment.
4 Analysis

In order to know when to apply more advanced evaluation techniques and translate that to applicable to support business decision making, one should consider two things: technological uncertainty or the complexity of the IT solution and the revenue uncertainty as a risk or volatility of the expected revenues enabled by the IT investment. More complex the technology (technological uncertainty is high) or more uncertain are the additional revenues or the cost savings, the more sophisticated should the evaluation technique be.

Let’s take a web based customer service channel investment as an example and assume that company has only call centers to answer customer service requests. The IT investment would be internet based self service solution implementation project. In order to enable the cost savings from decreased number of call center representatives the company implements a web based portal solution, invests in some additional hardware to maintain customer data and probably in software licenses of a off the self CRM solution. Expected cost savings can be quite well predicted beforehand, for example via customer survey, for example so that 50% of the customer contacts can be estimated to transfer to the e-channel. Therefore the revenue related uncertainty, although is present, is anyway quite well predicted beforehand. The used technology could, or should, be an industry standard which is supported and used widely. One could say that the technological uncertainty is also quite moderate, or even low.

So, what kind of IT investment evaluation technique should be used? Real options approach and maybe economic value added or just net present value and return on investment, analysis? Since the volatility is low one should not consider using a technique that counts it in. Therefore real options approach is not required. How about the economic value added, i.e. will the investment have relevant impact to the shareholder value? One could say, that maybe, for example, is the company is merely a customer service provider within the business-to-business markets or customer relationship management is one it’s core competencies. Then the usage of a more sophisticated evaluating technique, like the EVA than the basic ROI and NPV calculations are justified.

Discounted cash flow analysis has a built-in bias for large, capital-intensive projects for which the risks are predictable and manageable, and the nature of the IT investment will not change during the investments life cycle. However, for high-risk IT investments, there is a higher discount rate, consequently a lower projected value for the project.
Another feature of using discounted cash flow analysis to evaluate IT investments is the implementation roadmap. Once the initial small investment have been made, usually company is able to, or at least should be able to harvest so called quick wins, e.g. by decreasing the number of hardware costs while restructuring the IT infrastructure. By then the business environment might have changed, or there is new information available, and that’s when the real options analysis steps in.

Real options theory is enjoying great popularity in academic circles, producing innumerable conference papers full of sophisticated mathematical models. Real options have tangible business applications in that they systematize and quantify certain practices that often draw on intuition and anecdotal evidence. But can the theory of ROA support business decision making in real life and even more, be implemented as a part of IT government practices within corporations? This issue can be addressed by comparing the different options, like economic value added or net present value.

Despite the greater insight companies have today into the total cost of IT solutions at the outset of an initiative, projects frequently fail to yield the desired results, drag on longer than anticipated or suffer from unforeseen cost overruns. The reasons usually have less to do with the cost estimates or the technology itself but instead reflect the high degree of uncertainty and volatility of the company’s industry in general that demands constant adjustments and readjustments once a project begins (Scholz 2004).

Return on investment, economic value added, net present value or discounted cash flow do not sufficiently consider the impact that the volatility of the industry exerts on IT investments. This volatility is unlikely to subside soon and permeates every aspect of a business, and therefore should be taken into account.
5 Conclusions

Most businesses derive profits by employing IT capital projects and investments that assists or enable the company to prove goods or services. Careful selection of IT capital investments is extremely important. From a pure economic view, IT investments should only be selected if they will provide sufficient return to justify their costs.

Over the past several years, increasingly sophisticated analytical techniques for selecting the IT investments have been developed, but not implemented within corporations. Improved techniques, facilitated by the use of computers and financial calculators, have improved capital budgeting considerably. However, even with improved techniques and tools, too many capital budgeting blunders occur due to incorrect or unsound assumptions within IT investments. Faulty assumptions distort forecasts and cause relevant variables to be overlooked or potential financial benefits, increased revenues or cost savings are not realized due to lack of implementation. And when employing the most effective techniques and assumptions, managers can only minimize, not eliminate, the uncertainty. In making sound capital budgeting decisions, good managers employ available decision making aids while recognizing risks associated with uncertainty.

The real options approach works because it helps managers with the opportunities they have to plan and manage strategic investments. Stewart Myers of the Sloan School of Management at MIT coined the term real options to address the gap between strategic planning and finance (Myers 1984):

“Strategic planning needs finance. Present value calculations are needed as a check on strategic analysis and vice versa. However, standard discounted cash flow techniques will tend to underestimate the option value attached to growing profitable lines of business.

Corporate finance theory requires extension to deal with real options.”

Kulatilaka developed an approach to investment analysis of information technology (IT) projects based on real options (Kulatilaka 1996). The proposed approach appears to be a standard use of real options for investment analysis at the IT project level.

However, real options analysis is not a technique that replaces net present value technique - rather it expands on and improves the insights of strategic valuation. And on the other hand, real options analysis, ROA, approach has been one of the scapegoats of the IT bubble, when small e commerce companies’ value was highly overestimated. In addition, ROA is quite
heavy instrument to be used in analyzing small scale or replacement investments. For one time investments that are expected to last, say 5 years, NPV technique is quite adequate. If the investment period is even smaller, the investment itself very simple and the number of possible solutions are very small, even the simple payback period calculation could be enough. At least within privately owned small companies, who doesn’t have to care about dilution of the stock price but their purpose is simply to make money for their owners.

The number of valuation techniques is adequate and one should choose the one that best suits the business decision and environment on hand. Suggestions for additional research could be how to best combine quantitative IT investment evaluation with qualitative strategy alignment analysis of the chosen corporate strategy.
6 References

Accenture Educational and Training Material, 2001, June


