Managing IT for Value

John Favaro
Intecs Sistemi S.p.A.
Pisa, Italy
favaro@pisa.intecs.it

Abstract

The information technology (IT) environment has exhibited ever-higher levels of volatility in recent years, making it more difficult for managers to assess the value created by their decision-making processes. This paper describes an emerging paradigm of strategic options that integrates strategic and financial analysis.

Keywords*: value; economics; strategy; option; volatility*

1 Introduction

Recent years have witnessed the creation of immense wealth in the IT industry, coupled with a new, heretofore unknown volatility. Much of this volatility has been linked to another puzzling phenomenon: traditional rules of valuation do not seem to hold anymore. Profitless Internet companies routinely trade at stratospheric levels, while the valuations of other, profitable companies languish. It is natural to ask what the strategic and financial implications of this new volatility are for managers of IT organizations. This paper presents an emerging paradigm that sheds new light on the phenomenon of a rapidly evolving IT world.

2 Strategy and Value Creation

A fundamental question has arisen in the IT world: "Has the concept of IT value changed so fundamentally that the old rules of valuation don't hold any more?" Many strategists and economists feel that indeed something fundamental has changed. But we do not. The main drivers of value creation today *in any market* remain *market economics* and *competitive position*. The ME/CP framework, developed by Marakon Associates [9], illustrates these principles (Figure 1):

- The company strives to participate in the most attractive markets possible, and to leave unattractive markets. This implies that it is agile enough to enter and exit markets whenever desirable and necessary.

- At the same time, it strives to develop core capabilities and other strengths that improve its competitive position. As illustrated in the matrix, competitive position dominates market exit and entry. That is, a company in a poor competitive position even in an attractive market is likely to be unprofitable, but a company in a strong competitive position even in an unattractive market is likely still to be profitable.

Strategy formulation within this framework is all about trying to move the organization up and to the right in the matrix. It gives the organization a focus for strategy, and leads it towards the choices that are likely to create value.

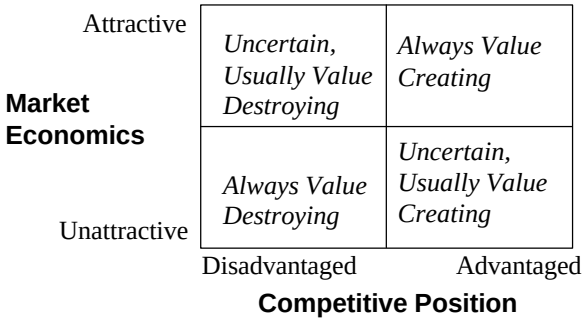

Figure 1: The ME/CP Strategic Framework

The principles embodied in the ME/CP framework are true in any industry, and remain true for IT. The change experienced by the IT industry in recent years is not a matter of *kind*, but of *degree*. Specifically, the degree of uncertainty has increased drastically in the IT world. Thus, even though the fundamental strategic value drivers haven't changed, it is understandable that questions are arising among IT managers about whether some kind of shift in perspective has become necessary.

What paradigm can be adopted to make IT strategy as effective as possible under these new conditions of uncertainty and volatility? Traditional paradigms such as TQM are not sufficient to drive IT management in this kind of world. They are basically *operational* frameworks—they do not *embrace change*. Indeed, such operational frameworks tend be difficult to apply in rapidly changing environments. Furthermore, their relationship to value creation is not always immediately demonstrable [8].

We propose an alternative paradigm: the continuous identification, evaluation, and implementation of *strategic options*. This is a paradigm that embraces change, even as it retains its link to the ME/CP framework. The more strategic options acquired by an organization, the more it can influence its position in the ME/CP strategic framework to participate in profitable markets and to improve competitive position.

There are many different kinds of strategic options in today's IT environment, many of which are not immediately recognized as such:

- A company may have developed or acquired valuable infrastructure technology, such as a set of financial business objects and frameworks giving it the option to enter a new, potentially profitable market of electronic banking.

- The human and organizational capabilities developed by a company may yield strategic options. If it has invested heavily in the recruitment of talented personnel, and invested heavily in training them in component-based development processes, then it may have acquired a strategic option to switch course rapidly in response to changing requirements, improving competitive advantage.
- The company may have created an equally valuable option to get *out* of an unprofitable market or project by employing IT resources that retain their value even if a project must be stopped. An example would be basing a development project on COTS software that could still be used in another context if the project is halted prematurely.
- When a new technology arrives on the market a company may have the option to wait and see whether the technology matures and is successful in the marketplace, before investing its resources in participating in that market.

By thinking in terms of the paradigm of continuous identification of strategic options, it is made explicit which choices are available, and when they can be made. This leads directly to the first key ingredient to managing IT for value: *active management*, the ability to react to change in the external world. It also lays the groundwork for the other key ingredient to managing IT for value: the *introduction of financial discipline*.

3 Finance and Value Creation

Strategy and finance have always had a symbiotic relationship with each other. Finance alone is inherently myopic. It has a restricted, project-level, worm's eye view of the world. Strategy elevates us to the level of the business, and is needed to provide the grand vision over an entire strategic direction. Yet without the sober, grounded numbers of finance, strategy is like a ship without an anchor. In fact, strategic and financial insight are *both* important, and complement each other.

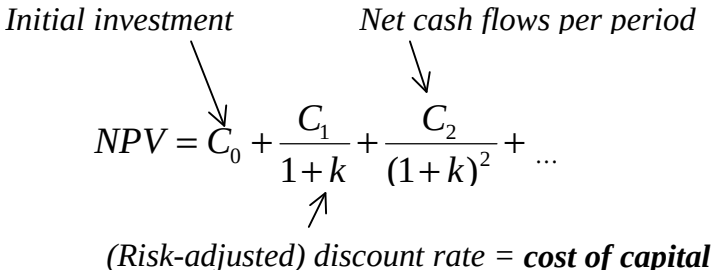

Figure 2: Net Present Value and Cost of Capital

Warren Buffet [3] has summarized the fundamental economic value equation succinctly: "Intrinsic [*economic*] value, is the discounted value of the cash that can be taken out of a business during its remaining life." *Discounted cash flow* [2] involves the weighting (discounting) of the net cash flows (revenues minus costs) that an investment will earn from now until the end of its life (Figure 2). The

discount rate is related to current interest rates (reflecting the fact that some revenue is received further in the future) and adjusted for business risk. If the initial (negative) investment is subtracted, it becomes the *net present value* or NPV [7]. Despite its straightforward formulation, NPV remains the bedrock foundation upon which all financial insight is built. For example, companies that practice value-based management use the discount rate as their "cost of capital" in monitoring their economic progress [9].

Thus, all modern thinking about value creation must depart from NPV. Present value concepts date from the time when financial economists were trying to find a rigorous way of pricing savings bonds and stocks. This technique for evaluating financial assets was then carried over to the evaluation of real-world assets. But the conceptual model behind the technique is *passive*, since stock and bond investments are passive, with linear payoff scenarios essentially and no strategic interventions to be made. Although this conceptual model is valid for many kinds of real-world projects, it is much less valid in the context of extreme volatility that was discussed earlier. When conditions change rapidly, management must be *active*, and payoffs can be radically *nonlinear*, depending on management reaction to opportunities or dangers [12]. IT managers have instinctively sensed this mismatch between the NPV approach and the volatility of today's IT climate, even giving it a name: *the trap of the negative NPV* [4]. New financial analysis tools are needed to overcome this trap.

4 Linking Strategic Options to Financial Options

Financial options are special forms of *derivative* securities—that is, their value depends on the value of an underlying asset. A *call option* gives the owner the right, but not the obligation, to buy an asset on a specified future expiration date, at a specified *strike* or *exercise* price. Similarly, a *put option* gives the owner the right (but not the obligation) to sell an asset for a specified price on an expiration date in the future. The position diagrams in Figure 3 illustrates payoffs of the options. Note one important characteristic: the payoffs are *nonlinear*, precisely the kind of payoffs that were highlighted in the previous section.

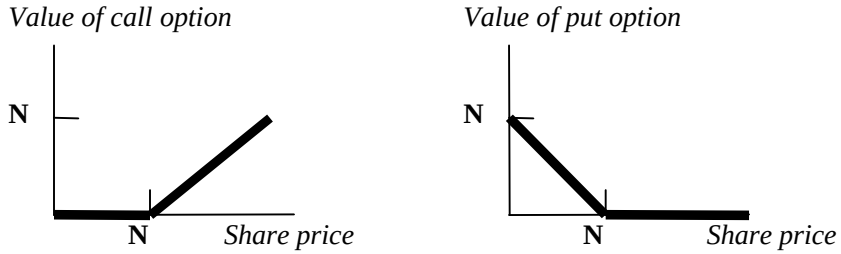

Figure 3: Position diagrams for call and put options

Options have been used for nearly three centuries both for speculation and for hedging. Despite their popularity, however, their usefulness was limited by the lack

of a rigorous theory of pricing. Such a theory was developed in 1973 by Fisher Black, Myron Scholes, and Robert Merton (winning them the 1997 Nobel Prize in Economics), and led to a new science of financial engineering, whereby derivative instruments are used in many inventive ways to manage risk in investments [2].

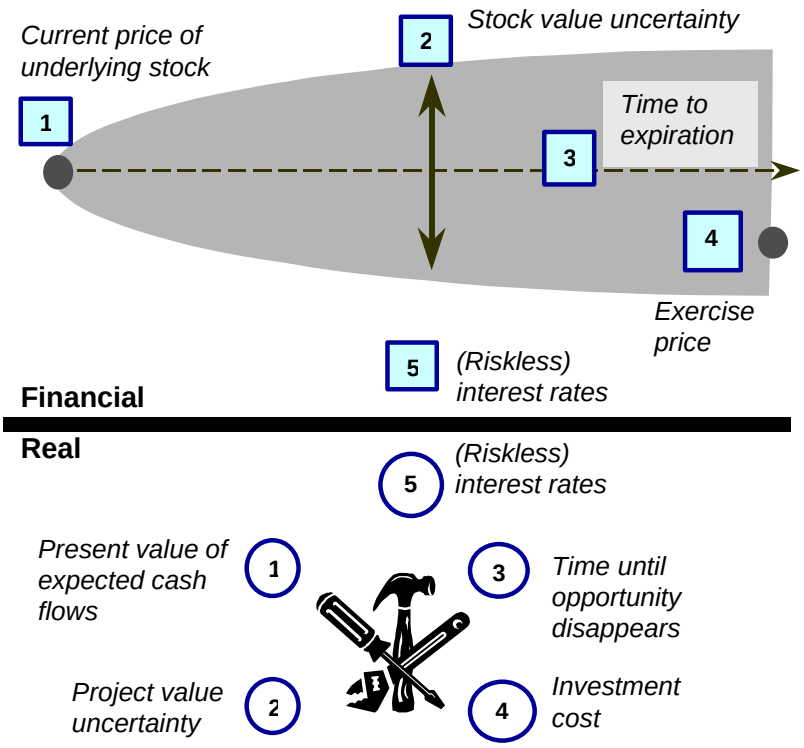

Figure 4: Financial and Real Option Correspondence

Once again real world has borrowed from the financial world in applying option pricing theory to the valuation of strategic options in capital investment projects. Figure 4 summarizes the parameters associated with financial options, and their mapping to real-world project parameters. Note that NPV can be viewed as a special case of option pricing theory, where the time parameter is collapsed to zero. To see why, note that the current value of the underlying stock (parameter 1) corresponds to the present value of expected cash flows of a project, its revenues. The exercise price (parameter 4) corresponds to the cost of the investment. If the investment is made now, then the value is of the option is simple revenues minus cost, or NPV. Parameter (5) preserves the fundamental idea of discounting.

Thus, option pricing theory does not *replace* NPV, which remains the point of departure for any serious financial insight, but *augments* it with new parameters. The time parameter permits reasoning about *when* an investment can be made. (NPV only permits reasoning about investments made *now*.) The volatility parameter

permits reasoning about the magnitude of the uncertainty of the future evolution of the investment value. (NPV permits only calculation of some kind of mean value of an investment, providing no insight on its uncertainty.) Finally, there is another important characteristic of an option not directly reflected in the parameters: the fact that it is a *contingent* investment, whereby a decision point is included, recalling the concept of active management. (In fact, this approach to financial analysis is also called *contingent claims analysis*.)

5 A Portfolio of Strategic Options

In the following sections, a set of examples will be presented illustrating the integration of strategy and finance with the principles described above.

5.1 Value-Creating Growth Opportunities

Growth has become the principal preoccupation of many companies today. Indeed, the stratospheric stock prices of many Internet companies have been linked to investor expectations of spectacular nonlinear growth opportunities (translating into greatly increased future revenues). In terms of strategy, this corresponds to the strategic option of new market entry. Yet many of these same companies have been accused of value-destroying growth. How can a company pursue aggressive growth strategies while retaining the financial discipline to be sure that its strategy is *increasing* value rather than destroying it?

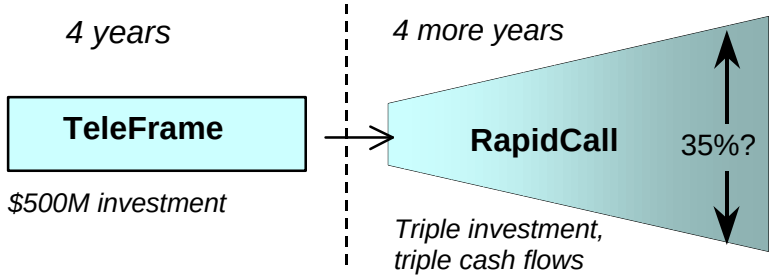

Figure 5: Growth Option for Telecom Investment

Consider a typical scenario (Figure 5) in today's fast-paced telecommunications industry. A major telecom supplier believes that there may be an enormous future market for customized call services, including a variety of personalized functionalities that can be configured for each individual client. To prepare for entry into this new market the company will have to create the infrastructure that permits such rapid configuration. The infrastructure consists of comprehensive object-oriented frameworks, components, and trained personnel, and will be created by an internal project under the code name of TeleFrame. It will take four years and an investment of 500 million dollars to create the infrastructure. At the end of four

years, the decision will be made (*active management*) whether to enter the market with a new venture called RapidCall, depending on factors such as current market conditions and the success of the TeleFrame project. Market entry would imply triple the original level of investment, with correspondingly larger revenues. However, a high level of uncertainty (estimated at 35%) is associated with these revenues. Details may be found in [5].

This is a typical scenario faced by many startups and venture capitalists: should the initial investment be made, given the future growth opportunity? Let us begin with traditional financial analysis. The Net Present Value (NPV) of the TeleFrame investment turns out to be -56 million dollars. The NPV of the RapidCall investment turns out to be -81 million dollars. No value-conscious manager would invest in TeleFrame based upon these figures. This, however, is a perfect example of the failure of traditional financial analysis to capture the full implications of strategic investment. A volatility of 35% means that the payoffs to RapidCall *might* be *much higher* than NPV predicts—in other words, nonlinear. The TeleFrame investment, even with its negative NPV, provides the opportunity to capture those nonlinear payoffs, and that opportunity has value that is not reflected in the NPV figure. In terms of options analysis, that opportunity is a *growth option*, and turns out to be worth 70 million dollars. Thus, the full, "augmented" NPV of the TeleFrame investment is 14 million dollars, a positive amount. Based upon this number, a value-conscious manager can proceed with the initial, strategic investment in the full knowledge that financial discipline has been respected.

5.2 Conservation of Business Value

The growth option of the previous section represented a case of new market *entry*. However, we saw in the discussion of the ME/CP framework that a company's market participation strategy also includes market *exit* considerations. In today's constantly changing information technology environment, the danger of a market segment becoming suddenly unprofitable is especially high, due to technology advances, competitor entry, and customer pressures. But the cost of abandoning a market segment can be high, and it is reasonable for companies to look for ways to protect their considerable investments if the decision to abandon should be taken. Much of the rationale for IT infrastructure revolves around exactly that: the conservation of valuable company assets.

At the same time that technology advances and business practices render entire market segments obsolete, they create entire new market segments. A company that is able exit, re-position itself, and re-enter at new levels of sophistication is in the possession of a considerable competitive advantage. This phenomenon is being seen now in the Internet environment, whereby companies are retooling their traditional products to perform in new Web-based markets. As a typical scenario, consider a company that has made its business in computer-based training, including CD-ROM packages and the like, which is vulnerable to the rapid incursion of new online technologies for course delivery. The company is now facing the decision of whether to make a largely defensive investment in infrastructure that will protect its core offerings (essentially, the training content) in case of the need to abandon the

old environment and migrate rapidly to a new technical environment. This *option to abandon* has strategic value, providing insurance against loss of revenue. But the investment would be costly, and management understandably would like to augment its strategic considerations with financial insight before taking a decision.

Figure 6 illustrates a sensitivity analysis that was carried out on the value of this option. Details may be found in [6]. The time horizon for making the infrastructure investment was estimated at eighteen months. Two important parameters were varied:

- The percentage of business value that would be preserved if the investment need to be abandoned. The more flexible infrastructure will conserve more value.
- The volatility of the market.

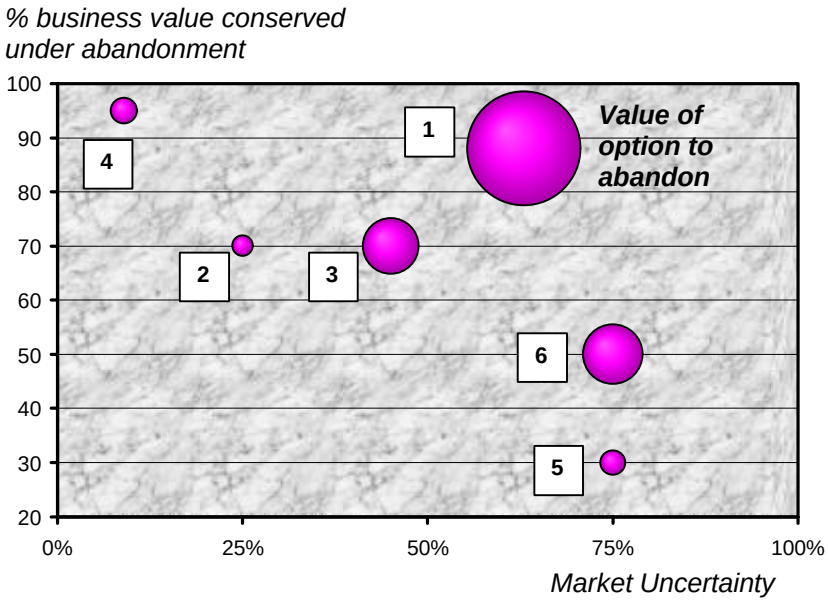

Figure 6: Conservation of IT Value in Abandonment Scenario

We can study the graph to learn some important lessons about the relative influence of each of these parameters on the value of the option. The size of each bubble is proportional to the value of the option.

- As expected, the value of the option to abandon is highest when the most business value is conserved, *and* the market is highly volatile. The largest bubble (*1*) corresponds to the case where about 85% of the business value is conserved, with a 60% volatility in the market.
- It is instructive to note how *little* the option is worth when there is little or no volatility. The smaller bubble (*2*) represents the option value at 25% volatility—nearly inconsequential. But moving horizontally to bubble (*3*) at 40% volatility increases the option's value dramatically. Why? Because no volatility implies no change—and thus no need to insure against change.

- Consider bubble (*4*). Even when an incredibly high 95% business value is conserved (in most cases unrealistic anyway), if the volatility is low, then the value of the abandonment option is still low. Compare this value with bubble (*5*), where at a relatively large 75% volatility, the option has nearly the *same* value even though only 30% of business value is conserved. Why? Because of the much higher likelihood that the option will need to be exercised.
- Moving up to bubble (*6*), we see that at those high levels of volatility (still 75%), the option value grows dramatically as it conserves more business value.

These scenarios help add financial insight to strategic considerations about whether it is better to make an extra investment in infrastructure. It can also help *develop* strategy. A company might identify those parts of its infrastructure that really are exposed to external market volatility—say, certain services in a volatile market—and separate them out from the parts which are not exposed to external volatility; and only invest in them. Notice that this has a technological counterpart in the ideas of layered design, such as three-tiered architectures, that separate system components that change from those that don't change.

5.3 The Economic Value of Flexibility

Taken to the logical extreme, the option to abandon, indeed nearly *all* other options, including the growth option (which is just really an option to expand operations rather than shrink them) are just special cases of the most general option of all: the option to switch use. This option goes to the core problem of IT strategy: *capturing the value of flexibility*. The concept has seized the imagination of the IT community in recent years in the expressions such as "the flexible software manufacturing system" and "the adaptive firm." It includes the entire gamut of organizational, human, and technical resources that contribute to the flexibility of a firm. Certainly, the whole concept of modular systems, component-based development, and reusable components, is tied up in the value of flexibility, the option to switch the use of resources from one task to another when advantageous.

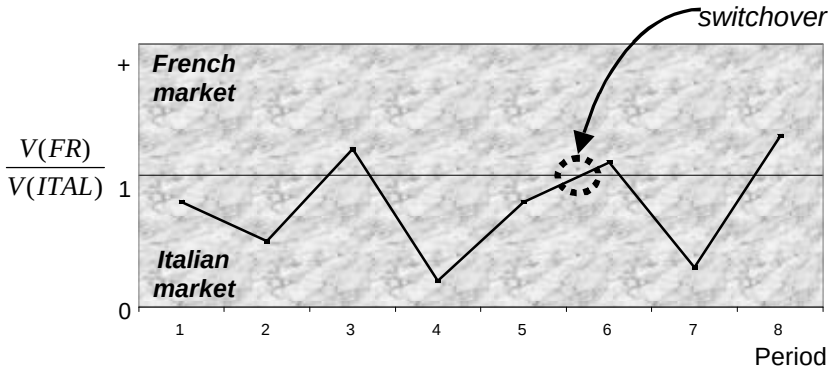

Figure 7: Project value ratios for Italian/French market scenario

Let us study how options theory can contribute to the financial analysis of the strategic concept of flexibility. Consider a scenario in which an Italian independent software vendor (ISV) operates in the Italian marketplace, with a set of appropriate organizational capabilities (including hardware, software, and trained personnel). Given opening of the European market through monetary union and other factors, it is now considering an investment to become an "adaptive firm" that could also operate in the French marketplace. Such an investment would imply the acquisition of a wide range of flexible organization capabilities, from re-training personnel to software systems that can be reconfigured to handle different national accounting policies. The company seeks to understand whether the cost of adding this strategic flexibility creates or destroys economic value.

We estimated the future evolution and volatility of the prospects for projects in the Italian market and in the French market. (Details may be found in [5].)

- For the Italian market, a higher NPV of project values was estimated, but with larger volatility.
- For the French market, a lower NPV was estimated, with a lower volatility.

The value of opportunities in each market evolves over time, and the ratio of values is shown in Figure 7. When the ratio is 1, the respective values are equal. When it is greater than one, then the value of opportunities in the French market is greater. With the respective choices of NPV and volatilities, the value of projects in the Italian market is *usually* larger, but sometimes the value of French projects will be larger. In that case, the adaptive firm has the option to switch over to the more valuable French project. Likewise, it has the opportunity to switch back when the ratio dips below the line again.

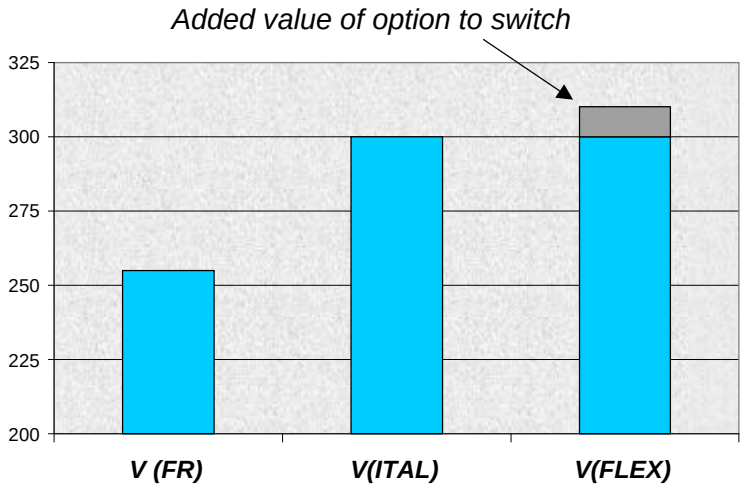

Figure 8: Added value of option to switch

Figure 8 illustrates the financial results. The value of the pure French market scenario is the lowest. The value of the pure Italian market scenario is about 300.

And we can see that the value of the flexible solution is about 310, adding another ten thousand dollars of value.

These numbers give management added financial insight to the strategic decision-making process. Note how the process forces the analyst to make explicit estimates of the various cash flows associated with flexibility, bringing out his implicit strategic thinking in a way that has financial significance. This is a fundamental consequence of integrating strategy and finance.

5.4 Time to Market and Market Timing

The previous three options regarded the flexibility to respond to change, in the best spirit of active management. Another type of option has a rather different character, living as it does in the dimension of *time*. Surely the most insistent mantra heard these days in the IT industry is *time to market*. The mantra is so widespread in the industry that many don't even think about whether there might be an alternative.

So let us scrutinize more closely the strategic rationale that underlies time to market. Much of the IT industry, especially in recent years, has been characterized by *new product introduction*. One valid way to increase the value of a new product is *branding*: by arriving first with a new service or in a new market, a company can establish its name and reputation. This is the single most important strategic consequence of rapid time to market.

But not every single business situation is a case of new product introduction in an emerging market. Indeed, there can be disadvantages to being first to market. The brutal forces of competition, lower quality of rushed products, and the steep, expensive experience curve are only three such disadvantages. Many leaders, like Microsoft and Intel, were not first to market. Finally, in many cases there is little chance of branding anyway due to the nature of the product (e.g. a compiler).

Sometimes the issue is not in fact time to market, but *market timing*. This can occur especially when a new technology has arrived, and companies are unsure when they should begin building products around it. Investing early runs the risk of betting on the wrong technology. Waiting too long can mean lost revenues.

Let us consider now how to value this type of strategic option and render it useful to the manager in his decision-making process. Consider a software company that would like to become an applications development partner with a major Enterprise Resource Planning (ERP) framework vendor. Given the significant costs of the investment to become a certified partner, it is important to team with the right vendor to maximize return on investment. Management has settle on a prospective partner and calculated that an immediate investment has positive NPV and could begin producing an annual cash flow equal to 15% of the gross value of the investment (see [6] for details).

Nevertheless, management has doubts about the timing of the investment. The ERP market is volatile. In addition, the future looks unclear for its prospective partner, who may not emerge as the market leader. Perhaps it would be better to wait a while to see how events unfold before investing. But how long should one wait before exercising this *option to defer* investment?

We can add financial insight to our strategic reasoning with the tools of options analysis. The holder of an option on a stock that pays *dividends* faces a similar problem to our prospective ERP partner. Dividends can only be received after the investment is made in the stock. Therefore the owner of the option must balance the advantage of waiting out the evolution of the stock price against the revenues that are lost during that time [2]. The following other assumptions we made to analyze the scenario:

- We assumed four scenarios for market volatility, corresponding to the four lines on the graph: 15%, 20%, 25%, and 30%.
- We assumed a time horizon of 18 months. Investment can be made at any time up to the next 18 months.

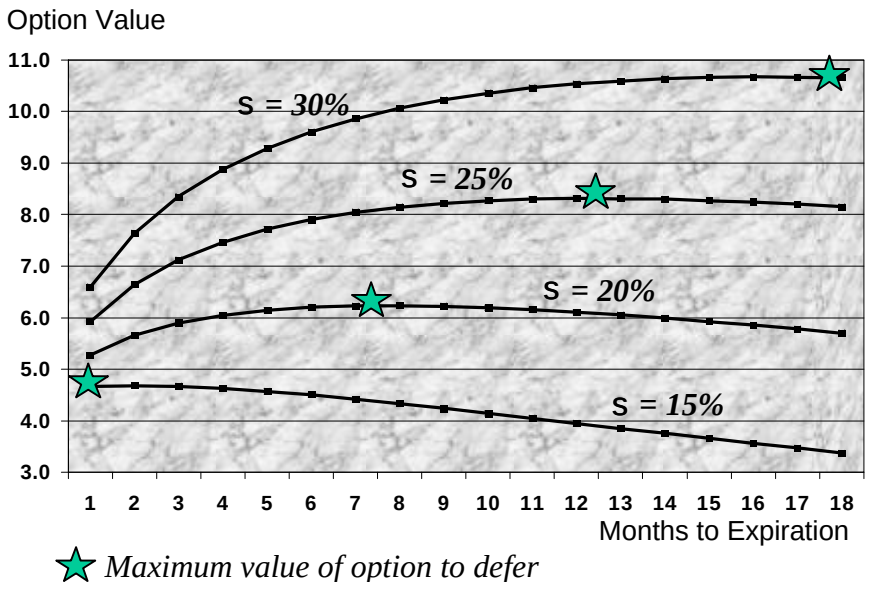

Figure 9: Market entry timing for ERP scenario

Figure 9 illustrates the tension between "value leakage" (lost revenues from not making the investment) and the resolution of market uncertainty as time evolves in the future. The value of an option increases with the time horizon and with increased volatility, thus counteracting the effects of value leakage.

- Consider first the graph of low volatility, only 15%. The value of the option to wait starts out equal simply to the NPV of the project, and descends from there. That is, there is so little uncertainty in the future that there is no value to waiting—on the contrary, value is *lost* because of the leakage in revenues.
- Consider the second scenario, at 20%. Note how the value of the option increases from the starting point with the effect of time and volatility, increasing until month 7, when the effect of value leakage begins to drag it down.

- In the third scenario, at 25%, the effect of volatility on the value becomes even more apparent. The value of the option keeps growing until month 12 before the value leakage begins to drag it down.
- Finally, in the fourth scenario, at 30%, the volatility is so high that despite all of the value leakage, it is still better to wait out the time horizon. It is a way of avoiding the regret of investing too early in case of a severe market downturn.

These scenarios are linked to the market, so they are able to communicate in a realistic way to the strategic decision-maker. The strategic decision is still his to make, of course, but he has more grounded financial inputs to help him in making that decision—yet another illustration of the integration of finance and strategy.

6 Implications for IT Management

Let us now discuss the concrete effects of a strategic options approach on IT management in a volatile environment. An organization practicing this approach will modify its processes, favoring the continuous identification, structuring, and analysis of strategic options. There will be *more* rather than fewer projects started, because the financial insight gained from analysis will allow managers to appreciate the upside potential of these investments (for large nonlinear payoffs) under uncertain market conditions. It also means, however, that they will have the financial discipline to *abandon* projects when their economic value no longer justifies the investment. Given the fact that many people develop an emotional attachment to "pet projects," the cultural change required in the enterprise can be significant. Conversely, it will be important for management not to penalize team leaders for abandoning unprofitable projects. Project abandonment needs to have a positive connotation if done for the right reasons, not the negative connotation that it has in a myopic perspective of project risk management [12].

The strategic options approach may appear destined to remain at the relatively abstract levels of strategic planning, never to be seen down "in the trenches" where actual development is carried out. Yet a nonlinear strategic options approach is already implicitly embodied in some modern development processes such as component-based development. Furthermore, an underlying rationale for many intuitive software development heuristics (such as information hiding) has been elicited by adopting a strategic options perspective [10].

The best example to date of a development process that is genuinely driven by a strategic options approach to IT is known as *Extreme Programming*, created over recent years by some of the most respected names in object technology. The motto adopted by its creators ("embrace change") encourages early and continuous identification of development options. It can lead also to some unexpected policies that go against conventional wisdom. For example, Extreme Programming discourages making up-front investment in a system capability even if it is technically possible and cheap, if the subsequent economic value delivered is in question. In other words, the authors have intuitively identified the *option to defer* in their process. They have also explicitly identified an *option to abandon*, and have emphasized its importance as a first-class citizen in the decision-making process, not to be looked upon as a sign of failure.

An analysis of other strategic options embedded in the Extreme Programming process may be found in [1]. Extreme Programming demonstrates that the strategic options paradigm can be adopted from the highest strategic levels all the way down to the lowest operational levels.

7 Conclusions

The gap between technological and financial engineering is narrowing rapidly. It is critical that IT managers familiarize themselves with the new financial analysis tools that are becoming available—failing to do so will make it much more difficult to manage for value in today's volatile environment. The paradigm of strategic options makes it possible to integrate strategy and finance more tightly, bringing them to bear on the major challenges that an IT manager must face today: evaluating opportunities, resource allocation, and flexibility itself.

References

1. Beck, K., Extreme programming explained: Embrace change, First edition, Addison-Wesley, New York, 1999
2. Brealey, R., and S. Myers, Principles of corporate finance, Fifth edition, McGraw-Hill, New York, 1996
3. Buffett, W., Berkshire Hathaway 1996 Annual Report, 1997
4. Clemons, E.K., Evaluation of Strategic Investments in Information Technology, Comm. ACM 1991, 34, 1: 22-36
5. Favaro, J., K. Favaro, and P. Favaro, Value Based Software Reuse Investment, Annals of Software Engineering 1998; 5:5-52
6. Favaro, J. and K. Favaro, Strategic analysis of application framework investments, in: Building application frameworks: Object oriented foundations of framework design, editors M. Fayad, D. Schmidt, and R. Johnson, John Wiley & Sons, New York, 1999
7. Favaro, J., A comparison of approaches to reuse investment analysis, Proceedings of the Fourth International Conference on Software Reuse, IEEE Computer Society Press, Los Alamitos, pp. 136-145, 1996
8. Favaro, J., When the pursuit of quality destroys value, IEEE Software 1996, 13, 3:93-95
9. McTaggart, J. M., P.W. Kontes, and M.C. Mankins, The value imperative, The free press, New York, 1994
10. Sullivan, K.J., P. Chalasani, and S. Jha, Software design decisions as real options, Technical Report 97-14, Department of Computer Science, University of Virginia, Charlottesville, 1997
11. Trigeorgis, L., Real Options, The MIT Press Cambridge, 1996
12. Amram, M. and N. Kulatilaka, Real options: Managing strategic investment in an uncertain world, Harvard Business School Press Boston, 1999