DARK POCKETS AND DECISION SUPPORT: THE INFORMATION TECHNOLOGY VALUE CYCLE IN EFFICIENT MARKETS

BY ROBERT A. JOSEFEK, JR. AND ROBERT J. KAUFFMAN, UNIVERSITY OF MINNESOTA, USA*

INTRODUCTION

During the last thirty years, the financial markets have demonstrated the remarkably dynamic nature of competitive advantage and reward derived from innovative investments in information technology (IT). Pioneers like Batterymarch Financial Management, whose early use of mainframe-based decision support for equity portfolio construction resulted in large profits for the firm, showed the direction that future investments in information technology would take in support of investment management.

More recently we have seen D. E. Shaw and Co. benefit from the substantial sums of money the firm invested in high-powered financial decision support systems. The firm was founded as a hedge fund in 1988 with $28 million of capital. As of 1996, it controlled over $700 million and on some days was responsible for as much as 5% of the total volume on the New York Stock Exchange (Aley, 1996). This firm's success is largely the result of $100 million in technology investment, primarily in decision support systems that mine huge databases looking for patterns and relationships among financial data.

But Shaw was not alone in making large bets on the value creating potential of information technology. Fidelity Investments, the mutual fund and investment management giant, uses neural network and genetic algorithm technologies to manage some of its $2.6 billion in assets (Aley, 1996). Another firm invested $35 million in supercomputing technology to obtain a two-second advantage in order to arbitrage stock futures on the Tokyo Stock Exchange (Economist, 1993).

The gains from these investments are fragile and not necessarily long-lived. Batterymarch Financial Management is a case in point. It illustrates what can happen over time when competitive dynamics and market evolution conspire to erode the advantage of a leading firm. Despite Batterymarch's early lead, large and effective investments in information technology by firms such as Merrill Lynch, Fidelity Investments and others in the mid-1980's significantly changed the competitive landscape. Even D. E. Shaw and Co.'s namesake founder and chief executive officer, David Shaw, says that despite his firm's success he would not enter the business of statistical arbitrage today. While his firm continues to perform well today, it simply has become too expensive for an aspiring competitor to recreate the infrastructure of analytical technology that his firm has developed and still be able to profitably enter that market.

** Robert A. Josefek, Jr. (RJOSEFEK.at.csomstudent@csom.umn.edu) is in the doctoral program in information systems at the Carlson School of Management, University of Minnesota. Before joining the University his work in the financial services and office equipment industries included technology project management and cost-benefit analysis.*

** Robert J. Kauffman (rkauffman@csom.umn.edu) is an Associate Professor of Information Systems and Decision Sciences at the Carlson School of Management, University of Minnesota, where he specializes in business information technology research and education. He is just finishing a special issue of the Journal of Organizational Computing and Electronic Commerce on information technoloy, finance and financial services.*

In this paper, we will argue that investments in information technology in financial markets settings pose a special problem for the investor. Financial markets are typically highly competitive marketplaces that significantly reward technological innovation leading to the discovery of new and useful information, although for just a brief time. As technology aids discovery and exploitation of "dark pockets" of market inefficiency – those areas of the market where information flows less freely or pricing technologies are less well developed – the innovating pioneers reap great rewards. Once more widely adopted, however, the same or similar technology quickly eliminates both the "dark pocket" and the opportunity for significant return on similar investments. In fact, the more successful the first entrant is in reaping gains by exploiting market inefficiency, the more rapidly others will rush to invest and deploy their own solutions, pushing the market very rapidly towards efficiency. This, in turn, further decreases the likelihood that any follower will be able to obtain an acceptable return on its investment in technology. This cycle of innovation and replication requires adjustments to be made in managerial expectations about technology investment payoffs. They must reflect the manner in which value from technological innovation is created and maintained.

The brief cycle times in which we see this process play out prompts us to examine such issues as how to construct decision support systems for longer term competitive payoffs, and how to assess the value of application-specific knowledge capital and its relative portability across firms. The short cycle time also may occur in other contexts that share the intensely competitive aspect of Wall Street's efficient markets. In such environments, one ought to expect the dynamics of technology investments and the impacts on business value to be quite different.

Investments in decision technologies used to support financial markets operations present something of a paradox. The financial markets, and currency markets in particular, represent some of the most efficient markets in the world. Information flows relatively unrestricted and prices are in a constant state of adjustment, reflecting the most recent information available to traders and analysts. The commonly held notion of efficiency – *that asset prices in the market already incorporate all the information one needs to know* – would tend to indicate that investment in information technology by any one firm could not lead to any particular advantage. Since the market price already reflects all the available information, no further action on the part of a buyer or seller ought to improve their position relative to others in the market. In this environment, making defensible investments in decision support systems would seem impossible.

But, because firms like D.E. Shaw and Co. demonstrate just the opposite – that there are indeed gains to be made from investment in financial market decision technologies, there is considerable competitive pressure to invest in, innovate, and protect value-producing technology. This paradox can be understood in terms of differences that occur in the *IT value cycle*, as we allow the nature of the market conditions under which technology investments are made to change.

HYPER-COMPETITION: THE IT VALUE CYCLE IN EFFICIENT FINANCIAL MARKETS

The business value created by investments in information and decision technologies is affected by the specific application and the environment in which the application operates. In the case of financial markets, efficient market theory provides a language we can use to describe and interpret market characteristics and the effect that different characteristics have on the potential to create value with a given technology.

MARKET EFFICIENCY AS AN IT VALUE MODERATOR

Efficient markets are those in which the price of a good or an asset reflects all relevant information. Economists and financial markets analysts consider variations on the efficiency theme ranging from the *weak form* to the *strong form*. The *New Palgrave Dictionary of Money and Finance* (1992, p. 788) defines the various conditions:

"The strong form of the efficient market hypothesis says that all information – public and private – is incorporated in asset prices".

"Under the semi-strong form of market efficiency, prices incorporate all publicly available information."

"Under the weak form of the efficient market hypothesis, prices accurately reflect everything that can be learned from past returns."

The strong form of efficient market reflects the idea that there is no cost or delay in assimilation of information. All relevant information is already reflected in the price of a good when the buyer or seller enters the market so there is no opportunity to create value or generate gain because of superior information or technology. The weak form efficient market theory relaxes the information-price link to the extent that not all information is immediately reflected in the price of a good. As a result, gathering and processing information faster or more cheaply can result in competitive advantage, particularly when combined with appropriate capabilities for pricing and marketing products. It is on the latter end of the market efficiency spectrum that the speed, bandwidth, and raw processing power of information technology may be able to create value.

Because, by definition, it is impossible to gain advantage in strong form efficient markets, the potential to leverage investments in financial decision technologies must lay in more weakly efficient markets. Furthermore, different levels of efficiency within weakly efficient markets provide clues as to the appropriateness of different information technologies. For example, consider the case of location-based arbitrage in which a basket of securities trades for a lower price than an index reflecting the contents of the basket trades on another exchange. This creates an opportunity for a firm to simultaneously buy the basket and sell the index to earn a risk free return.

In time, others may recognize and move to take advantage of this opportunity. (This actually occurred during the Black Monday Crash in October 1987 in the American financial markets, when information dissemination was slow in the marketplace due to the historically high trading volumes around the country). As a result the market becomes more efficient and we see prices in the two markets move closer together. In this simple example, an appropriate technology could speed price collection, transfer, comparison, and perhaps simultaneously execute trades in different markets. A seemingly small advantage can be extraordinarily valuable. This is just the sort of opportunity we were referring to in the case of the investment made by a firm that arbitraged stock futures on the Tokyo Stock Exchange.

How might investments of this sort be undertaken by firms that consider making them? We expect firms to make investments in financial decision technologies where the expected return, taking into account the likely responses of able competitors, adequately reflects the nature of the risks that the firm must undertake. Obviously, the more money a firm believes it can make or the greater the return on investment it thinks can be achieved, the more likely it will be to commit. As firms identify investment opportunities, implement new decision technology, and correct market inefficiency, they eliminate the opportunity to gain additional advantage

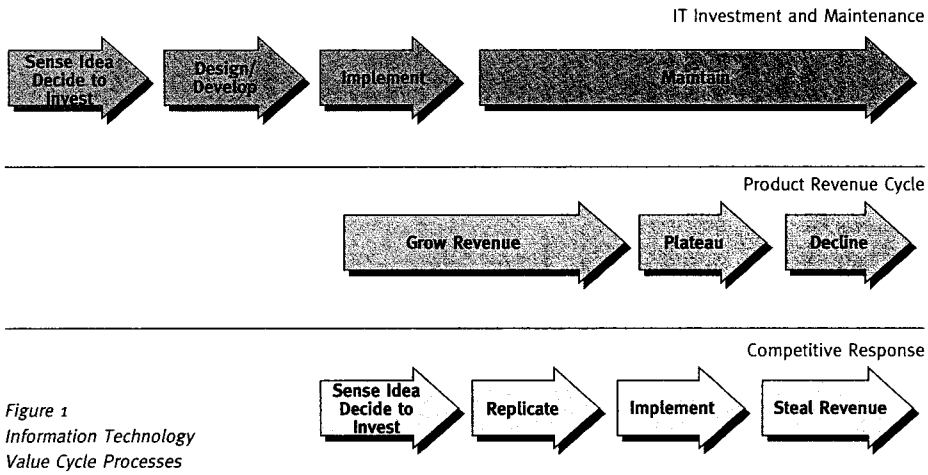


Figure 1
Information Technology Value Cycle Processes

in that area. As time passes and the most attractive opportunities are exploited, firms must move to invest in decision technology projects involving some combination of greater cost, higher risk, and smaller return.

Recalling David Shaw's comment on how difficult it is to get into the business of analytical trading today, we note that the remaining inefficient portions of the market ought to be increasingly resistant to exploitation, even with the more capable decision technology and data mining approaches that are available today. As a result, the opportunities that offer the greatest financial rewards for the investor will therefore be those requiring advances and innovations in financial economics (the "technique" and not the "technology"), significant capital investment and higher levels of project risk than firms may have been willing to bear in the past.

CHARACTERIZING VALUE OVER TIME

Financial markets also illustrate how potentially brief the period of advantage can be for innovating firms and how quickly high returns can evaporate. Since trades take place in an open market, and the community of traders is known, there are many opportunities for observing the activities of competitors. Once a firm begins to exploit an opportunity, it is quite likely that competing firms will observe its activities and be able to assess the costs and benefits of implementing a similar technology investment strategy.

As a result, any advantage that has accrued to a first mover, assuming there is not some barrier to innovation or implementation, may be fleeting. This kind of outcome indicates that the speed with which analytical technologies in financial market decision support can be implemented is crucial. The first mover gains by stretching its lead time; the early follower gains by exploiting inefficiency in the market while there is still some left to exploit. Once this is no longer the case, or if the investment becomes more costly than expected, a firm is likely to take steps to reduce the risks it faces.

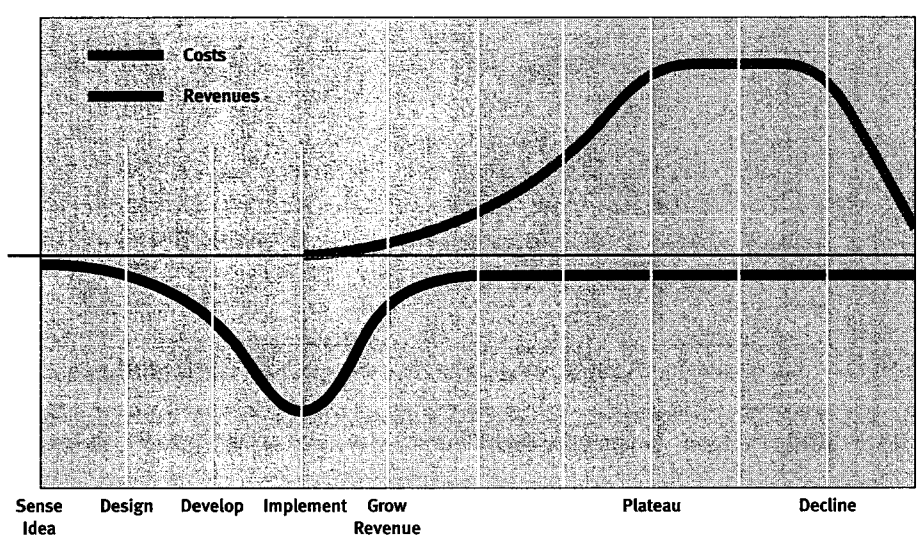
The *IT value cycle* captures the changing character of opportunity to gain from investment in information technology during the time between initial investment and elimination of opportunity. Let us begin with the key activities that characterize the cycle from the viewpoint of a single firm. (See Figure 1).

An innovative firm identifies an opportunity and decides to invest in technology to create and capture value. That investment decision launches a period of systems development including analysis, design, development, implementation, and maintenance. Upon implementation, the firm enters a typical product cycle of increasing use, plateau, and decline. Extending this cycle to the competitive case involving multiple firms means that as competing firms perceive opportunity they too will make investments to capture a share of the value previously available only to the first mover. Once ready, competitors implement to capture a share of the value.

Each key activity is associated with either a use or creation of resources, leading to real costs or new revenues. However, the period from opportunity identification through implementation is characterized principally by increasing costs. (See Figure 2).

By contrast, the period following implementation is characterized first by increasing revenue and then by declining revenue. (Of course, it is possible to create

Figure 2 Revenue and Cost Flows in the Single Firm Case



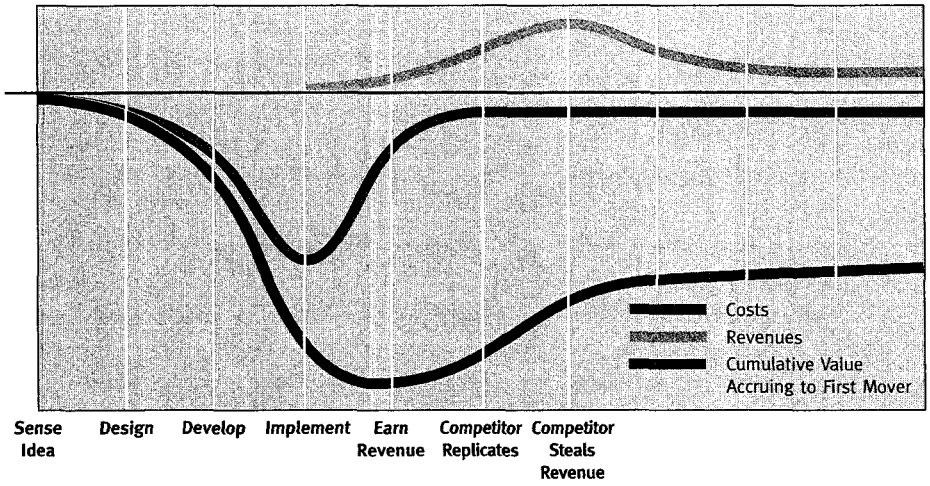


Figure 3
Revenue and Cost Flows in the Single Firm Case

revenue flows during the first period and post implementation maintenance costs are frequently significant.) Introducing competitors' activities can also affect the cycle. For example, when a competing firm enters the market, the usual outcome is that total market revenue is divided between the two firms. This investment pattern continues as other firms that have the resources necessary to steal market share attempt to do so. This yields revenues for the new entrants until the total benefit is split among so many players that the marginal return no longer justifies new investment. The larger the perceived payoff, the faster others will rush in.

Competitive response has a substantial impact on the reward a firm actually derives from investment. If competing firms do not quickly enter the market, any first mover advantage is maintained. However, if competitors perceive an opportunity to create significant value and have (or can obtain) the resources to implement similar technology, they are likely to quickly enter the game and cut short the first mover's potential gain. Figures 3 and 4 illustrate the impact of changes in competitor response by considering the competitive case in general, and the competitive case with an especially aggressive competitor. (See Figures 3 and 4.)

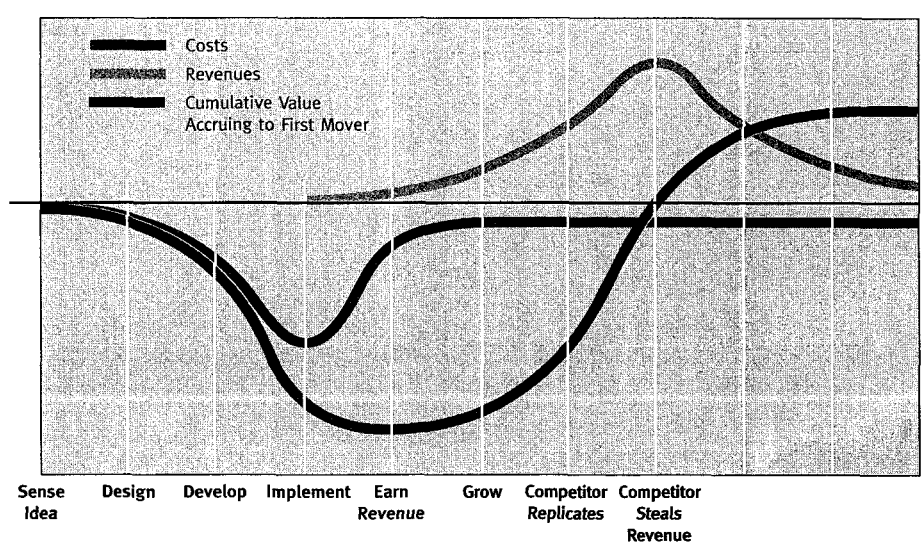
While the time and the magnitude of the curves are somewhat arbitrary in the graphics, they offer some important intuition for the reader. All three revenue and cost flow diagrams reveal the same cost and initial revenue curves but the revenue over time and total value captured by the first mover change dramatically. In the general competitive case, the firms revenue stream is reduced shortly after implementation when another firm implements a competing technology. However, the first firm still earns a positive return on its investment. In the case with an aggressive competitor, the total value accruing to the innovative first mover is less, and, although it is still increasing, overall profit is actually negative. This reflects the effect of early implementation by the aggressive competitor.

We see that earlier recognition, replication, and implementation by a competitor translates into more revenue for the competitor and less for the innovator up to the point where the investment results in a loss for the innovator. By contrast, a later response and entry by a competitor allows the innovating firm to realize a greater percentage of the total benefit to be had from the innovation. In the financial markets, however, this value cycle is often compressed by the speed with which the market is able to react to innovation. This occurs because so much of what is happening in the financial markets is observable by other competitors as it happens. As a result, there is significant motivation on the part of the innovator to extend the cycle and find other ways to make the value of financial decision technology defensible.

MAKING FINANCIAL DECISION TECHNOLOGY VALUE DEFENSIBLE

Using the IT value cycle highlights some of the important problems associated with investment in innovative information technology. For example, it suggests explanations for why, under the conditions that exist when investment decisions are made, a technology may promise great returns and then appear to fail in delivery. This is often the case when competitors quickly enter the same market and eliminate a first mover advantage. Or per-

Figure 4 Revenue and Cost Flows in Competitive Case



haps the technology itself is highly interesting and beneficial, but the implementation costs are too high for any competitor other than the first mover to product a profit.

This observation raises several key questions:

- Under what circumstances can we improve the likelihood that the business value of an investment in financial market decision technology will be defensible?
- What can be done to lengthen the value cycle?

The following tactics provide an initial set of approaches to consider.

TACTIC #1 – ADOPT AN IT INVESTMENT STRATEGY THAT EMPHASIZES CONTINUAL INNOVATION

As we have illustrated, investments in innovative decision support technology for the financial markets are likely to involve substantial capital outlays, high risk, and potentially short windows of time during which the opportunity can be fully exploited. This high risk, high return environment requires subtle but significant changes in the way managers typically think about technology, investment, competitive challenges, and the regulatory environment. For example, when considering these investments, we can focus on the returns that can reasonably be expected over the duration of the value cycle (given available information) for a single investment.

Alternatively, we can view value assessment from the perspective of a continual innovator, for whom value creation in the longer term is tied to retaining their edge on the competition. By applying this more strategic notion, we look beyond a single cycle for the proposed application and towards a basis for establishing "defensible business value" over time. Viewed this way, one of the most important potential value generators associated with technology is the extent to which it creates various kinds of flexibility for the firm: to respond rapidly, to support a new product first, to scale up an operation across multiple locations, etc. At the limit, flexible technology may allow the firm to rapidly shift focus, from one inefficiency to another, as the opportunity to exploit diminishes.

TACTIC #2 — INVEST TO CREATE INFRASTRUCTURE AND OPTION VALUE

If an investment made today creates a follow on capability to make another investment in the future that yields opportunities for profit, then the investment creates a "real option" (the right but not the obligation) to make that future investment (Dixit and Pindyck, 1995). When the investment is in information technology, it may be particularly valuable if some future system can only be built with some reliance on what was developed as a part of the earlier investment.

The resulting leveragable infrastructure impacts the value cycle in two significant ways. *First*, since the system can be built only if the initial investment is made (in infrastructure, for example), the initial investment acts as a partial entry barrier, increasing the duration of the cycle during which only firms that made the initial option creating investment can profit.

Second, valuation of proposed projects during initial investment decision making can now include the value of the newly created option, as well as the benefits derived directly from the initial application. Using this perspective we can see that as a firm makes successive investments in information technology options, it can create a portfolio of strategic assets (or options) that can be brought to bear (exercised) as market and competitive conditions become better known to the firm.

TACTIC #3 — BUILD UNIQUE RESOURCE ADVANTAGE

Firm-specific resources and competencies comprise another factor that can affect value cycle duration. Over time some firms are able to build unique combinations of skills, intraorganizational relationships, knowledge about their business environment, and analytical tools that other firms may not be able to imitate. If competitors lack these important resources and cannot substitute other resources that are available for purchase on the market, a significant competitive advantage can be created for the resource rich firm (Dierickx and Cool, 1989).

In the case of financial decision technologies, firm specific investments in infrastructure may provide the capability for faster or more complete opportunity identification, faster application development, cleaner implementation, or more effective exploitation of opportunities that arise (Clemons, 1991). Each result increases either the duration or the magnitude of the value cycle benefit derived from investment. J. P. Morgan's recent efforts to create innovative risk management product offerings illustrate this well.

REFERENCES

The Economist. "A Survey of the Frontiers of Finance: The Mathematics of Markets." The Economist, October 9, 1993, pp. 2-22.

Aley, J. "Wall Street's King Quant." Fortune, February 5, 1996, pp. 108-12.

Brynjolfsson, E. "The Productivity Paradox of Information Technology." Communications of the ACM (36:12) December 1993, pp. 66-77.

Clemons, E. "Evaluation of Strategic Investments in Information Technology." Communications of the ACM (34:1), January 1991, pp. 22-36.

Dierickx, I., and K. Cool. "Asset Stock Accumulation and Sustainability of Competitive Advantage." Management Science (35:12), December 1989, pp. 1540-1511.

Early in the 1990s, the firm sought to push the envelope on the development of proprietary computer-based analytics to assess the financial risk associated with the variety of financial positions undertaken by the firm. The original intent was to enable the bank to better control its own profitability and performance. The state-of-the-art at the time had grown to recognize that risk ought to be monitored on the basis of the likelihood of overnight loss for a given position, buttressed by cross-correlation with the movements of other financial instruments that were held in portfolio. This way, so the firm argued, it was possible to identify the extent to which exposures canceled out or subjected the firm to multiple or "domino losses."

The approach the firm developed for its own use came to be known as "RiskMetrics," and was highly successful within the company. It embodied improvements in "technique" (advances in financial economics) as well as in the "technology" (the RiskMetrics analytical software). This approach enabled senior management to retrospectively assess "value at risk," both to gauge the firm's exposure to unexpected losses and to prospectively determine how to allocate scarce risk capital across its businesses. Overall, the developments that resulted were based upon, and extended, the firm's unique resource base. For additional information about RiscMetrics see http://www.jpmorgan.com/RiskManagement/RiskMetrics/RiskMetrics.html.

TACTIC #4 – PROTECT INVESTMENT

Around the same time, Bankers Trust, an arch-rival of Morgan in wholesale and international financial services, was working on similar ideas that came to be known as "RAROC", for "risk-adjusted return on capital." Similar to Morgan, Bankers Trust also possessed unique resources that allowed the firm to develop these innovations, and implement them effectively within the firm. However, once the word got out on the street about these new and innovative approaches to risk management and the allocation of capital, the race was on to recruit these firms' top analytical talents in the financial economics of risk management and risk management systems development. Both firms responded strategically, to extend the revenue-generating portion of their innovations' IT value cycle, though they did sustain significant personnel losses to the rest of the market. Observing some of the developments in the RAROC and the RiskMetrics capabilities, it appears that one significant way in which each firm protected its investment was to begin to differentiate what each would do in the future. (For example, Bankers Trust's approach seems to be more tailored for portfolio investment management purposes, while RiskMetrics focuses upon wholesale international financial services risk management. Note that J. P. Morgan also capitalized on their investment in RiskMetrics by introducing CreditMetrics, a credit risc assessment technology for traditional loans, receivables, and other instruments (http://www.jpmorgan.com/RiskManagement/CreditMetrics/CreditMetrics.html).

Dixit, A., and R. S. Pindyck. "The Options Approach to Capital Investment." Harvard Business Review, May/June 1995, pp. 105-15.

McAndrews, J. "The Evolution of Shared ATM Networks," Business Review, Federal Reserve Bank of Philadelphia, September/October 1995, pp. 3-16.

Newman, P., M. Milgate, and J. Eatwell, (Eds). "The New Dictionary of Money and Finance," New York: Stockton Press, 1992.

Sandler, N. "Real Rocket Science Comes to High Finance: Former Soviet Defense Brains Are Now Juicing Up Returns for YES, Inc." Business Week, January 17, 1994, pp. 69-72.

Steiner, T. D., and D. B. Teixeira. Technology in Banking: Value Created, Profits Destroyed. New, York: Irwin Professional Publishing, 1990.

For additional information about RAROC see http://www.bankerstrust.com/soft/rroc2020.html.

TACTIC #5 – REMAKE THE MARKETPLACE BY SETTING STANDARDS, FORMING ALLIANCES AND SELLING OUT

Morgan moved to make RiskMetrics broadly available in the marketplace, to offer other firms a means to benchmark risk. Bankers Trust followed suit, by marketing its innovation under the name "RAROC 2020." Morgan seems to have been highly successful in this effort, forging a product marketing alliance with Reuters, the global financial news network. As a result, RiskMetrics is well on the way to becoming a world-wide standard, ensuring Morgan that the competitive advantage it reaped from the core innovation would be sustained, if only in the form of licensing and product use fees. Today, just about every financial institution of a reasonable size has begun to work with these new risk management concepts. So the competitive advantage associated with implementing an overnight volatility and instrument cross-correlation monitor of financial risk is no longer what it once was.

TACTIC #6 — ASSESS THREATS TO COMPETITIVE POSITION AND STABILITY OF KNOWLEDGE RESOURCES

Although investments in information technology can provide competitive advantage by creating both a portfolio of real options and an enabling infrastructure, it is the competitive reaction in the marketplace and regulatory changes that may ultimately determine the value created by any single investment that is directed at a specific kind of financial market inefficiency. Competing firms will take actions to maximize the value of their own position (or at least to minimize their losses) and that may result in less than maximal value for any single firm. For example, strategic blocking can occur when a competitor moves to prevent a firm from exploiting an opportunity, rather than trying to exploit the opportunity itself.

This occurred in the United States in the 1980s when cooperating retail electronic banking networks cut short the profit and customer base building opportunities that could otherwise be derived from investment in proprietary electronic banking networks by competing firms (Steiner and Teixeira, 1990). When several banks form a network of automated teller machines, costs can be spread over the member banks and their joint customer base. As a result, average cost decreases and even small banks can play a game that would otherwise be available to only those with substantial resources. Even banks that initially made investments in proprietary networks have been forced to join networks and cede their advantage (McAndrews, 1995). We see the same kinds of developments today in the United States in the debit card business arena.

The reality of competitive response is an important, often ignored factor in investment decision making. Regulatory changes can have a similar impact: they may cut short the profitability of otherwise highly valuable investments or prevent others from mounting a competitive threat. Certainly airline and telecommunications regulation and deregulation have had these effects, creating a more defensible value cycle for some firms.

The picture is further complicated by the relative mobility of knowledge capital in the financial markets. Expertise in the technology of decision support for financial markets is available for hire and not tied to a specific firm. This is critical since essential expertise is frequently tied up in a single individual or small group. Recall D. E. Shaw and Co. whose nucleus is a handful of carefully selected Ph.D.s (Aley, 1996). As a result, some firms refuse to identify key employees because of the fear and the experience of having talent snatched away by competitors (Sandler, 1994). Yet, at the same time, the rapidly falling cost of computing power and increasingly powerful system development tools would appear to be easing barriers to entry. The overall picture that emerges is that investing in decision technologies for financial markets operations is a risky business in which large investments can have huge payoffs – or not. So the question of technology investment evaluation is critical.

CONCLUSION

Decision support in financial markets is but one context within which we can demonstrate the IT value cycle and related industry and competitive factors. Yield management systems in the airline management industries represents another case, among many others, in which significant investments can result in unique competitive advantage. During the 1980s and well into the 1990s, airlines made large investments in information technology so they could more reliably predict demand and fine tune their revenue yields. Just as in the financial markets, airfares are set within a highly competitive marketplace, making it necessary for a well managed firm to emphasize revenue yield performance.

United Airlines' and American Airlines' efforts with their APOLLO and SABRE travel agency automation software follow very closely the J. P. Morgan RiskMetrics example we discussed earlier. Each of these system investments was highly profitable in its own right early in its value cycle. However, later, as it became possible for other firms to replicate similar reservation system capabilities, the most innovative airlines innovated further. *First*, they sought to grow their installed base of locations in travel agencies. *Second*, they further differentiated what their systems could do from those of the competition. Over time, the computerized reservation systems capabilities came to be powerful vehicles for sampling market demand at a range of prices, eventually leading American and United to begin to make a science out of yield management. *Third*, with solid and capable infrastructures in place that support highly effective decision support for pricing, the focus has shifted away from "technology" and back to "technique." Now, more than ever, we are seeing a renaissance in methodologies that firms are experimenting with to fine tune their capabilities to manage revenue yield. We also see similar approaches being extended to just about every industry in which one can earn a revenue stream from a fixed asset (rental cars, hotel rooms, railroad freight cars, mall shopping space, television and radio advertising time slots, etc.).

It is also interesting to note another instance where government regulation plays a role in the outcome. For example, in the United States, where interurban rail passenger service (AMTRAK) is subsidized and regulated, yield management systems are subject to very different set of investment evaluation criteria. Since the interurban rail service is focused on maximizing revenue yield to cover unsubsidized costs – and not to create profits for AMTRAK – we are likely to see much less investment occur. Although this really isn't quite our "single firm case" –because rail travel can be substituted with air travel or by a driving a car – it nevertheless suggests the importance that the competitive environment has on IT investment and the resulting value cycle.

Through this brief exploration of the IT value cycle concept we can begin to see investment in information technology in a new light. We can see the value of including in our information technology investment decision making an assessment of real options, firm-specific resources, competitive perception and response, and of resource mobility. Our work echoes that of Brynjolfsson (1993) and others in that it illustrates the need for a more formal understanding, a higher theory, of IT value in the context of industry structure and competition. The IT value cycle provides a basis for such a competitive theory of IT value.