

**EVALUATING INVESTMENTS IN INFORMATION TECHNOLOGY:
THEORY VERSUS PRACTICE**

by

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ABSTRACT

Advances in microchip technology have dramatically increased the performance and reduced the cost of computers in the last decade. Given that, the role of information technology has evolved from one of increasing operational efficiency to one of business transformation. Seeking competitive advantage and increased market share in addition to operational efficiency, firms have increased spending on information technology to an average of 7% of revenues.

This thesis explores:

- the evolving role of information technology;
- how finance theory can be applied to valuing investments in information technology; and
- how firms perform valuation in practice.

In addition, the thesis examines how standard valuation techniques, such as net present value, can be applied to information technology investments. Recognizing that many of the future benefits are intangible, the application of techniques such as decision tree analysis and real options valuation are explored as a means of evaluating benefits that cannot be easily quantified in monetary terms.

Interviews were conducted with information technology managers from three firms in the banking industry. The results of those interviews present an overview of the firms' information technology practices. The research and interview findings support the idea that intangible benefits must be considered when valuing information technology investments, particularly when evaluating "strategic" projects. All three firms value information technology projects that are considered "strategic" on the basis of pursuing business direction rather than the result of a net present value calculation.

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CHAPTER 1

INTRODUCTION

The decade of the 1990s has wrought dramatic changes in the economic structure of almost every country in the world. As the influences of free trade, competition on a global scale, and the impacts of the information revolution bring even greater change, the economies of developing countries are becoming dominated by service industries. One common characteristic of service industries is the requirement to manage information rather than to manage physical things in order to create value (Quinn, 1995).

As the need for information continues to proliferate on every front, the use of information technology has transformed the way business is conducted. In the past, information technology was viewed as a way to improve efficiency and trim costs. Now, information technology plays a key role in the management and distribution of intellect within a firm: computers manage inventory levels and perform credit risk management, and firms rely increasingly on information technology to provide linkage and distribution capabilities to suppliers and customers.

The primary force behind the information revolution is advances in the production and capacity of microelectronics, specifically, the microchip. Computing power that once cost a million dollars and filled an entire room now costs \$5,000 and sits on a desk (Allen and Scott Morton, 1994). With the decline in the cost of microelectronic technology, powerful information technology such as computers, software and telecommunications equipment has become prevalent throughout almost every aspect of conducting business.

In this new environment of increased global competition, advanced information technology, and broader market access, firms are striving to effectively leverage human and capital resources to produce greater profits. Proponents of the information revolution are convinced that information technology provides many opportunities for globalizing company markets, extending sales networks, and empowering workforces (Negroponte, 1995).

In an effort to bring such beneficial effects into their own firms, corporate investment in information technology is increasing. As the price of information technology continues to fall, firms are reengineering their operations and investing in computers, software, and telecommunications equipment so they will become more efficient and competitive. Recent figures show that with prices for computers and office machinery falling 13% per year for the past half-decade, outlays for producer durable equipment as a share of nominal GDP has risen from 6.5% in 1991 to 8.2% in 1995 (Farrell, 1995).

Post-Project Productivity Gains are Questioned

Contrary to expectations, the increased investment in information technology has not automatically led to measurable productivity improvements. An econometric analysis of the productivity associated with investments in information technology by Loveman found that capital expenditure on information technology had only a low marginal impact on output or on labor productivity (Allen & Scott Morton, 1994, p. 85).

A study by Brynjolfsson (1993) suggests that the ability of a firm to realize value from the deployment of information technology is as much a function of effective management as it is the increased technological capability. Brynjolfsson sites mismanagement as one of the possible reasons for the lack of measurable productivity increases. His reasoning is that the lack of explicit measures of value make information technology investments particularly vulnerable to misallocation and overconsumption

(p. 76). A 1994 study by Brynjolfsson and Hitt based on a survey of over 400 companies suggests that there is evidence of a return on investment in information technology of over 50% (Farrell, 1995, p. 142).

While researchers are trying to find more effective ways to measure the impact of information technology on productivity and profits, firms continue to invest millions of dollars because beyond the likelihood of increased efficiency, information technology also has the potential to provide a wide range of strategic benefits such as competitive advantage and increased market access (Porter, 1985).

Ex-Ante Investment Valuation

With information technology expenditure ranging from 4% to 10% of revenue, it becomes even more important to justify the value that a firm expects to realize if it decides to increase its investment in information technology (Farbey, 1993, p. 7). Investments in information technology are generally subject to the same scrutiny as investments in other long-term assets. By definition a long-term asset is acquired and paid for before it generates any benefit. Capital budgeting is a collection of tools that planners use to evaluate the desirability of investments in long-term assets. The fundamental issue that is addressed when performing asset evaluation is whether the future benefits justify the initial cost (Atkinson, 1995).

Capital budgeting techniques, such as discounted cash flows, can be used to evaluate investments in information technology. But capital budgeting techniques alone cannot provide the guidance required for making effective decisions regarding information technology investments because many of the benefits that arise from the increased use of information technology are intangible. Some of the value achieved through the use of information technology, such as increased customer satisfaction, are difficult to measure and quantify. Therefore, there is some question as to whether or not information

technology investments should be valued using the same standards as other long-term assets.

Objective of the Thesis

Much of the current literature provides extensive analysis and research aimed at measuring the effects of information technology on productivity. In this thesis I will explore techniques for performing ex-ante evaluation of information technology investments. I will outline several valuation methods and then describe how three financial institutions perform valuation in practice.

Data Collection Methods

Data was obtained through a focused literature search in the areas of information technology, project evaluation, capital budgeting, and related issues. Readings included academic research documents such as books and articles written in the business press. Annual reports and internal documents were obtained from three banking firms.

Interviews were conducted with senior-level information technology managers in banking firms to explore how the firms are managing their information technology investments. The interviews give an overview of current practices in the financial services industry. Interviews took place in the firms studied and on average lasted approximately two hours each.

CHAPTER 2

THE EVOLVING ROLE OF INFORMATION TECHNOLOGY

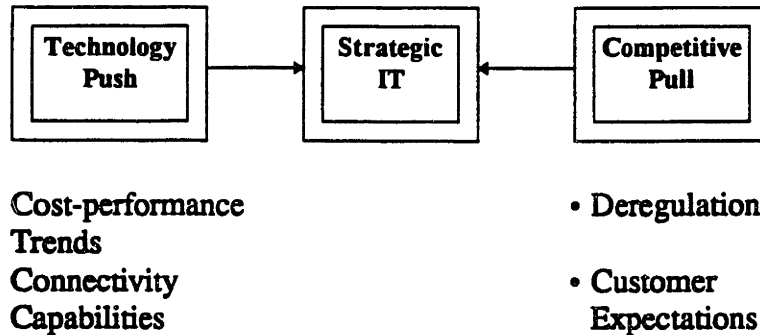
This chapter describes how the role of information technology has changed, and looks at the management of the information technology function in a firm. Continuing advances in information technology coupled with political and social change have combined to affect the way firms structure and organize themselves. As a result, information technology now plays a broader, more strategic role than merely automating support functions.

Role of Information Technology

The impact of early information technology was generally limited to an identifiable segment of the business. For example, in the banking industry in the late 1970s, clerical and accounting procedures became simpler with the introduction of electronic data processing. It was relatively easy to justify the need for or further expansion of information technology investment because its benefits were readily apparent in increased productivity or cost savings as the result of staff reduction.

At MIT's Sloan School of Management, the "Management of the 1990s" research program examined why information technology had begun to play a more a pervasive role throughout organizations. Figure 2.1 illustrates why the use of information technology has changed over the last decade.

Figure 2-1
Why the role of information technology has changed



Source: Farbey, 1993

Scott Morton (Farbey, 1993) defines "Technology Push" as rapid advances in the capabilities of information technology combined with substantial cost reductions. Improvements in computing power and communication capabilities afford a much broader range of uses for information technology. He describes the broadening of competing sources in the midst of a changing economic environment as "Competitive Pull". Scott Morton also describes how increased customer expectations and changing political and economic conditions are affecting organizations. Customer expectations regarding price and quality are said to be heightened. Changing political structure and a reduction in regulation has increased competition and business opportunities. These changes cause firms to put a greater emphasis on individual customer satisfaction and force them to become more competitive on a worldwide scale. Combined, the concepts of technology push and competitive pull are driving firms to expand the use of information technology to achieve market positioning and superior financial performance.

Why Firms Invest in Information Technology

Firms invest in information technology because ultimately they expect to realize increased profits. Such expected profits may be derived from short-term increases in efficiency or longer-term increases in market share. Regardless, when a firm chooses to

invest in information technology, it does so in the belief that such an investment will provide value to the organization.

Lee (1995) presents the results of a survey of fifteen information technology managers who were asked why their firms invested in information technology. Lee incorporated into his survey various categories of benefit and then asked the managers to focus on what portion of their information technology budget was spent for each category of benefit. Lee's study revealed four main reasons why firms invest in information technology:

1. To respond to industry forces such as regulatory change or increasing competition;
2. To facilitate the development, distribution, and sales of new products or services;
3. To increase customer satisfaction; and
4. To improve the quality of existing products and services.

A similar survey conducted by Brynjolfsson (1996) asked approximately 300 information technology managers what benefit they expected to receive from information technology. The top six items mentioned were customer service, cost reduction, timeliness, quality, support for reengineering, and flexibility.

It is interesting to note that the top categories in both surveys represent intangible benefits that are hard to measure. Moreover, information technology encompasses all functions of a firm and thus is becoming a necessary part of doing business.

Strategic Advantage or Strategic Necessity?

In the face of increasing global competition, firms are leveraging information technology to achieve competitive advantage. According to Michael Porter (1985),

technological change is one of the principal drivers of changes in competition. Porter suggests that information technology can significantly change the nature of competition in any industry by changing industry structure, creating competitive advantage, and spawning new businesses. Porter's "Five Forces" -- the power of buyers, the power of suppliers, the threat of new entrants, the threat of substitutes, and rivalry among existing competitors -- enables one to segment and study the structure of any industry. Information technology can be used to alter conditions under each of the five forces and thus change industry structure and attractiveness.

For example, information technologies that require large investments can raise barriers to entry, such as Citibank's vast rollout of Automated Teller Machines (ATMs). As a result of Citibank's willingness to make such an investment, investing in state-of-the-art ATM technology is now presumed to be a necessary cost of doing business in commercial banking. In another example, electronic databases such as Lexis/Nexis provide a substitute to research firms, libraries, and trade journal subscriptions. Electronic data interchange (EDI) gives power to buyers and allows them to circumvent middle distributors and suppliers by going directly to the manufacturer or service provider.

One way to increase competitive advantage is by creating a cost advantage or differentiating service in a way that a competitor cannot easily copy. For example, Belgacom, a consortium including U.S.-based AirTouch International, is a recently privatized cellular network operator in Belgium. I observed that Belgacom's CEO saw the advantage of using its American partner's customer service and billing information system to support Belgacom's commercial operations. Not only did this enable Belgacom to automate the network provisioning function (distinguishing between customer features), but the system also provided flexible pricing which was helpful in quickly introducing competitive pricing strategies in a previously monopolistic environment. The use of information technology afforded Belgacom a competitive advantage from both a cost and service differentiation perspective.

Information technology can also spawn new businesses from existing operations. For example, American Airlines (AMR) created its Sabre Group to generate additional revenues by leveraging their reservation system. The Sabre Group, which licenses and provides support for Sabre, generated \$348 million in revenues for the airline in 1994 (AMR internal document, 1995).

Other firms are developing new lines of business selling information that is captured as a by-product of their operations. Grocery stores use bar code scanners and membership discount cards to facilitate the capture of real-time demographic data about their customers and their buying habits which in turn can be sold to market research companies and food manufacturers.

Porter contends that companies that anticipate the use of information technology will be in control of future events. "Companies that do not respond will be forced to accept the changes that others initiate and will find themselves at a competitive disadvantage" (Porter, 1985, p. 158). In the future, managers may consider vast investments in information technology as insignificant against the potentially larger losses the firm might incur if it fails to sustain competitive advantage or hold market share because its information technology systems are inadequate. When evaluating information technology investments, it is important to explicitly evaluate the cost of not investing. It cannot be assumed that the status quo will be maintained.

Managing Information Technology

Information technology can be found throughout most large organizations and is now relevant to everything from efficient operations to the development of new products and services. It is important to note that an information technology investment in itself does not ensure a firm's success, but rather requires an appropriate business strategy to guide it. In many cases, the failure to realize benefits from information technology

investments is directly related to an organization's inability to integrate the use and management of information technology into the mainstream of the organization (Henderson, 1990: cited in Mahmood and Mann, 1993).

Because of the prevalent nature of information technology and the increased opportunities for using it to achieve strategic advantage, the management of information technology requires more general management leadership than ever before (Farbey, 1993). Farbey describes three reasons why general management expertise is critical to leveraging information technology:

- Information technology affects many strategic issues and can play a key role in the competitive positioning of a firm. Many organizations can no longer compete without the use of information technology. Using information technology can help a company to gain or lose competitive advantage and affect market share.
- Information technology is at the core of many business processes. It is now being used to restructure business processes in an effort to eliminate functional boundaries and streamline operations. Information technology's existence crosses functional and organizational boundaries within a firm and requires both technical and functional expertise to be managed effectively.
- On average, capital expenditures for information technology is increasing and now accounts for between 4 and 10% of revenue.

An overriding theme in the business press over the past five years is that investments in information technology should be linked with the firm's business strategy and reflect the company's goals and priorities. The role of the Chief Information Officer (CIO) is to ensure that information technology requirements become an integral part of the business strategy and assist the firm in choosing information technology investments that add value to the company. CIOs need to develop an information technology strategy and architecture that will provide linkage between business and technology. They must also develop guiding principles that state how the company plans to use information technology

over time to aid in decision making and facilitate the connection between business and information technology (Davenport, 1989, p. 131). Strassman (1990) also stresses that effective information technology investments should be linked with and be an attempt to further the firm's overall business strategy.

Many firms are taking the advice of these experts. In an August 1995 press release, Pratt and Whitney's President, Karl Krapek, announced the appointment of a Vice President of Information Technology who reports directly to him. The Vice President of Information Technology will be responsible for developing and implementing a comprehensive information technology strategy to support the research, engineering, manufacturing and business goals of the company. Krapek stated, "the capacity to move information across our organization quickly and seamlessly is crucial to sustaining competitive advantage. The establishment of the executive committee level position recognizes the important role information technology plays in our future" (Pratt and Whitney press release, 1995).

CHAPTER 3

HOW INFORMATION TECHNOLOGY INVESTMENTS ARE EVALUATED IN THEORY

Evaluation Process

There are two principal processes that comprise any investment evaluation: data collection and decision making. The first process, data collection, is concerned with estimating the costs and benefits of the investment under consideration. The second process is an assessment of the cost and benefit of data and then making a decision whether or not to proceed with the project.

This chapter presents an overview of the typical costs and benefits that should be considered when valuing an investment in information technology and describes several decision-making techniques for evaluating the cost-benefit data.

Data Collection

Successful management of information technology investments requires the same effective financial planning and evaluation as other capital investments. However, information technology investments differ from typical long-term assets in that they can be more difficult to evaluate. What makes information technology valuation difficult is that some of the benefits which are produced, such as information, are intangible. The information produced by an information system may have a positive impact on a

manager's ability to make a decision but it has no easily measured value. There is great difficulty in estimating the value of intangible benefits.

Forecasting Benefits

For purposes of the analysis in this thesis, benefits are categorized as "tangible" and "intangible." Tangible benefits are those which can be measured and translated into monetary terms. Intangible benefits are those which cannot be directly measured. Both tangible and intangible benefits need to be considered in forecasting.

Intangible benefits can be further categorized into user-oriented and opportunity-oriented benefits. User-oriented benefits include value derived by the users of the information technology such as increased access to information. Opportunity-oriented benefits refer to new business opportunities that may become available if a project is undertaken. For example, developing a new system using advanced technology may improve the organization's ability to develop additional systems based on advanced technology. The first experience establishes technical feasibility and may reduce the development and implementation cost of future projects (Dos Santos, 1991). For example, learning from the first project can be applied to subsequent efforts. Some investments represent an opportunity to limit future losses. For example, an investment in systems to enhance customer service can be viewed as an opportunity to defend existing market share from a competitor.

To identify potential benefits from information technology investments, it is necessary to view the effect that the project will have on the firm as a whole. The potential benefits can be categorized as operational, managerial, or competitive positioning. It is useful to assess the impact in each of those areas.

- Operational Efficiency. Operational efficiency is one of the main beneficiaries of information technology investment because of increased productivity and labor substitution. Ease of operation, convenience, and integrated functions all add efficiency and end-user satisfaction. An intuitive graphical user interface can reduce the need for end-user training. Information technology enables access from remote locations and eliminates distance barriers. One of the most prolific information technologies that is used as a labor substitute is the widespread implementation of voice response units (VRU). By combining computers and communication technology in a VRU, customers can access needed information without speaking to Customer Service personnel or making direct calls to specialists, thereby reducing the need for staff. Additional benefits can take the form of:
 - data center operational cost reduction (storage, printing, leasing of fixed assets and property),
 - improved work environment,
 - increased accuracy,
 - support for future growth without additional overhead,
 - ability to link with suppliers and customers,
 - reduction in inventory levels (just in time),
 - flexibility, and
 - enhanced learning.

- Managerial Control. Information systems have been found to improve managerial control over operations through increased performance reporting to managers. For example, data about customer service representatives' (CSR) performance, such as how many customer service calls are closed per hour, is automatically recorded allowing managers to closely monitor CSR

performance. The effective deployment of a Management Information System (MIS) can provide information which managers use to increase the quality of their decisions. Managers are able to make decisions faster and with fewer errors.

- Competitive position. Investments in information technology can create significant barriers to market entry by competitors (such as a network of ATMs) and change or enhance a firm's market position. Information technology can enhance competitive position through:
 - improved quality,
 - increasing market access,
 - facilitating the introduction of new products and services,
 - enhancing supplier and customer relationships by providing direct linkage,
 - creating or increasing switching costs for customers, and
 - reducing product lead times.

The above factors are by no means a complete list of potential benefits. Each firm within an industry will have different characteristics and business drivers that shape how information technology can provide benefit. The key is to go beyond mere technical considerations to determine what value the information technology can add to the overall operations of the firm and its position in its industry. It is also important to note the difficulty of quantifying many of the above-mentioned benefits.

Forecasting Costs

It is also necessary to forecast the cost of the information technology over its life. Even with experience, estimating costs of developing major applications is difficult and

unreliable (Farbey, 1993: p. 13). Forecasting costs tends to be even less certain when the investment is based on new technology because of the increased level of uncertainty. In addition, there are costs that are often overlooked or underestimated such as organizational change, training, and system maintenance.

It is essential to consider costs over the life of the information technology, therefore the expected life of an information system must be forecast. While static information systems such as accounting and payroll tend to have a seven to ten year life, customer service applications in competitive industries must be replaced more often.

Technical obsolescence and changing business requirements make lifetime costs difficult to estimate with a high degree of certainty. The following categories of expense should be considered:

- Labor - including employee salaries, taxes, benefits, and overhead.
- Materials and supplies - office supplies, computer supplies, and software.
- Equipment - rental or lease payments, maintenance payments, purchase payments, and/or the effects of depreciation.
- Facilities - rental or mortgage payments, increased or decreased utilities, telephone and communication expense, increased security.
- Services and contractors - insurance expense, service bureau fees, outside contractor fees, transportation and shipping, and increases in allocated overhead.
- Training - training for users, support and other personnel and organizational change.

Decision Making

The next section describes how standard capital budgeting techniques and other tools can be applied to evaluate the cost-benefit data and make a recommendation as to

whether or not to proceed with a project. No one technique is the clear choice in every situation. It is important to note that ignoring the valuation of an item because it is too hard to estimate is not optimal. It is better to estimate the value than allow the default of zero.

Technique 1: Cost Benefit Analysis

One of the most widely used methods for evaluating information technology investments is basic cost-benefit analysis (Farbey, 1993, p. 97). Using this method, the costs of developing, implementing, and operating the information system are estimated and compared with the anticipated benefits the system will provide. This method involves the following steps:

1. ***Estimate the cost of developing, implementing and maintaining the system.***
 - Included in this estimate is the cost of converting from existing systems or implementing a new system. Typical costs are: training for users and other personnel, data conversion from existing systems, and simulated business trials to prepare the firm to use the new information technology. This estimate includes the cost of managing the project and running and maintaining the system in the future.
2. ***Estimate the value of the expected benefits***
 - Benefits can take the form of direct savings through reduced operating costs, or a less tangible form such as a reduction in cost due to fewer inventory stockouts. For direct benefits, the monetary value is calculated based on the savings or cost reduction. Under this method, assumptions are made about potential savings that may result from the intangible benefits. For example, one might attribute additional sales revenue as the result of a reduction in lost sales due

to out-of-stock conditions. This activity introduces a level of subjectivity to the monetary value attributed to benefits.

3. *Estimate the expected life of the system.*

- Systems may need to be replaced because of technological obsolescence or because they no longer meet the needs of the firm. Typically, back office applications such as accounting and payroll have longer lives than front-end applications such as a customer service interface. However, it is difficult to predict future technological advances and business needs. Therefore it is easy to misjudge the expected life of a system.

4. *Compare the benefits and costs over the life of the system.*

- The data collected and tabulated in the above steps is used to evaluate the investment. The benefits are compared to the costs. Typically, the data collected is subsequently used in one of the valuation techniques described below. The more subjectivity inherent in the data collected, the less accurate the valuation will be.

Technique 2: Return on Investment

Return on investment (ROI) relates profitability to the investment required to generate the profitability. The standard ROI calculation is as follows:

$$\text{ROI} = \frac{\text{Operating Income}}{\text{Investment}}$$

The problem with valuing information technology investments using straight ROI is that much of information technology's value may not be derived directly as an increase or

decrease to operating income, and therefore may not be represented in the numerator of the ROI calculation.

Technique 3: Discounted Cash Flow

One widely used valuation method is discounted cash flow (DCF). Under the DCF method, forecasted cash flows resulting from the investment are discounted to reflect the time value of money. DCF analysis relies on the Net Present Value (NPV) formula to discount the forecasted cash flows at the specified discount rate. The result is the present value of the investment. The NPV formula measures the forecasted value of the investment (cash inflows over the life of the project) against the cost of the investment (cash outflow at the start of the project). The resulting net present value represents the value of the investment today. The formula is as follows:

$$NPV = C_0 + \sum_{t=1}^{\infty} C_t / (1 + r)^t$$

where

C_0	=	the cash outflow at the start of the project
C_t	=	the cash inflows over the life of the project
t	=	the project life
r	=	the discount rate

The discount rate should reflect both the risk of the project and the minimum return that the organization must earn on its investment in order to meet its investor's expectations. The firm can decide that the discount rate merely reflect the cost of capital or they can require an additional return. Typically, firms use discount rates that are too high in the belief that this is compensation for increased risk. According to Brynjolfsson (1996), 8-10% discount rates (in real terms) are appropriate for valuing information technology projects, in contrast with 20% values that are typically being used. High discount rates bias investments toward projects that pay off in the short term, leaving firms at a disadvantage in the long term.

The following example illustrates the application of NPV to evaluate an investment in information technology.

A firm is considering a project to develop a home page on the Internet. The home page will provide information about the firm and has the ability to distribute additional marketing material to consumers who visit the site and request such materials. The infrastructure and user interface will require new hardware, communication equipment, and system and application software. It is estimated that the creation of the home page will cost \$100,000. The expected value of the project is derived from decreased activity for customer service representatives who would normally receive calls from customers requesting information. It is estimated that the life of the proposed system is one year. It is estimated that the system will provide a savings of \$38,500 in labor costs.

Project	Initial Investment	Cash flow in year 1
Home Page	\$ 100,000	\$38,500

Assume that the firm has determined that a discount rate of 10% is appropriate for this project. NPV for this project is calculated as follows:

$$-65,004 = -1000,000 + \sum_{t=1}^1 38,500 / (1.10)^t$$

The NPV of this project is \$ -65,004.

Since negative NPV projects should not be undertaken, this project would be rejected. However, the existence of intangible benefits should be considered before the project is rejected. It could be that the value of increased market access and direct linkage with customers warrants investing in this project.

Brynjolfsson (1995) recommends an enhanced DCF technique for evaluating investments in information technology. The known cash flows are evaluated using a reverse NPV technique to determine the gap between the NPV and the desired return. The resulting NPV gap represents a monetary measure of benefit or value that must be derived from the user or opportunity benefits if the project is to be undertaken. The formula for calculating NPV gap is:

$$\text{NPV gap} = \text{Original Investment} - \text{NPV}$$

To illustrate, let the desired return in the above example be the recovery of \$50,000 of the original investment.

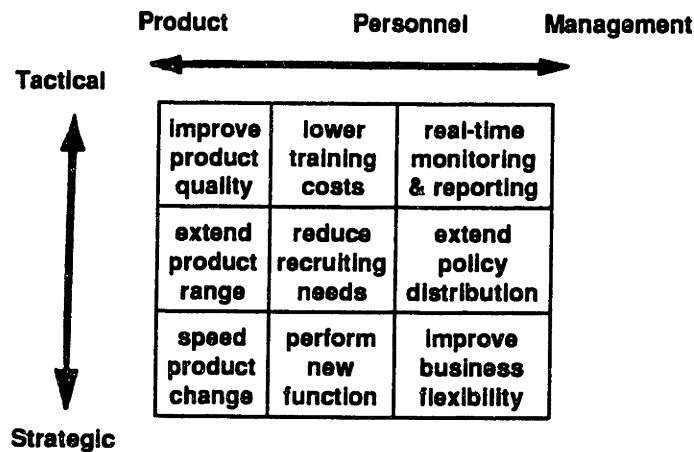
$$\text{Therefore NPV gap} = \$ 100,000 + -65,004$$

$$\text{NPV gap} = \$ 34,996$$

Since the desired return is \$50,000, the intangible benefits must exceed (\$50,000 - \$34,996) or \$15,004.

In this case, the enhanced DCF model results in a dollar amount which represents the benefit which must be generated by the intangible user and opportunity-oriented benefits. A firm can ask, "Is the value of the intangible benefits enough to overcome the gap between the net present value and the desired return?" "Do the intangible benefits exceed \$15,004?"

Brynjolfsson (1996) suggests the use of a benefits matrix to explore the link between benefits and business priorities. The benefits matrix is a flexible tool that can be used to add structure to the evaluation of intangible benefits when deciding if their value exceeds the NPV gap. It is useful to consider how the expected benefits of the investment relate to business drivers of the firm. The benefits matrix can be used to link benefits to beneficiary (as shown) or possibly time-frame to function.



Source: Brynjolfsson, 1996

The key benefit of using NPV to value an investment in information technology is that it permits an analysis and comparison of alternative project values such as cash flows, the cost of capital, and the desired NPV. However, there are several difficulties in using the application of NPV to evaluate information technology investments. These are: the requirement to identify and estimate benefits as future cash flows; identification of the cost of capital and accounting for its variation over long periods of time; and the tendency to ignore strategic investments because of the uncertainty of the resulting value.

A key problem in relying solely on DCF analysis lies in the need to forecast the expected benefits in monetary terms. It is important to recognize that it may not matter if the investment has a positive net present value, only that it is superior (or less negative) to the alternatives. The rejection of a project does not necessarily mean the status quo will be maintained. The failure to undertake a project could mean the loss of market share to a competitor who is willing to undertake a seemingly negative net present value project (Clemons, 1991).

DCF is widely recommended by finance experts as the correct procedure to use when evaluating capital investments. Although discounted cash flow analysis is extensively used in organizations with the approval of financial specialists, DCF techniques

have come under increasing criticism for their inability to value investments that are strategic in nature. DCF analysis has been blamed for many of the ills that have befallen American industry, i.e., the failure to modernize, the short-term focus of investment decisions, and the lack of adequate funding for research and development (Dos Santos, 1991).

Technique 4: Payback Period

The payback period is a simple method of evaluation. It involves computing the length of time it takes for cash inflows to recover an initial investment.

Under the payback method, the initial outlay is required to be recoverable within a specified period of time, for example three years. The payback period of an investment project is determined by counting the number of years it takes for the cumulated forecasted cash flows to equal the initial investment.

Consider the payback rule applied to the previous example:

Project	Initial Investment	Cash flow in year 1
Home Page	\$ 100,000	\$38,500

Cash inflows of \$38,500 occur only in the first year. Therefore, the initial investment of \$100,000 is not recovered in three years. The payback rule also tells us not to undertake the project.

While this method is straightforward, it is generally not recommended by finance experts because it does not consider the time value of money. Finance experts note that the wrong kind of projects may be accepted using this method simply because they generate immediate cash flows. Moreover, like NPV calculations there is no obvious way

to include the intangible user-oriented and opportunity-oriented benefits under the payback method. Nevertheless, it is widely used in organizations (Atkinson, 1995, pg. 407).

Both the DCF and payback techniques are based on some implicit assumptions. They assume that if the firm does not undertake the investment now, it will not be able to do so in the future. One key limitation is that they do not consider the value of managerial flexibility, nor the value of possible follow-on investments arising from the project. Irreversibility and the possibility of delay are important characteristics of most information technology investments (Kambil et al., 1991; Dixit, 1994).

Options

Kambil et al. (1991) suggest that information technology investments often provide firms with "real options" representing increased opportunities for future growth. "Real options" are opportunities for acquiring and expanding real assets and are analogous to financial options. The same concepts that are applied to value financial options can be used to evaluate strategic investments that have the potential to increase market share; to provide new sources of revenue or to adapt to a new business environment. The flexibility that arises from such options can increase the expected value of a project.

Kambil proposes a framework for valuing investments in information technology based on options theory. The framework suggests a process for deriving a value for each option by determining the value of an analogous financial option. This technique permits a price to be calculated for the value of the flexibility to exercise a given "right" in the future. These "rights" liken an option such as the expansion of a information system in the future to being able to buy stock in a company at a fixed price in the future. Under options theory, the more uncertainty about the future the more valuable the option is.

The following generic real options suggested by Brealy and Myers (1991, p. 529) can be applied to most information technology investments:

- Follow-on or expansion option: An investment in technology today can enable a firm to exercise a follow-on project in the future.
- Abandonment or salvage option: Information technology can be put to alternative use if the original use is rendered unsuccessful or no longer useful.
- Wait and learn option: A firm can defer the decision to make an investment in information technology in an effort to reduce risk or cost.

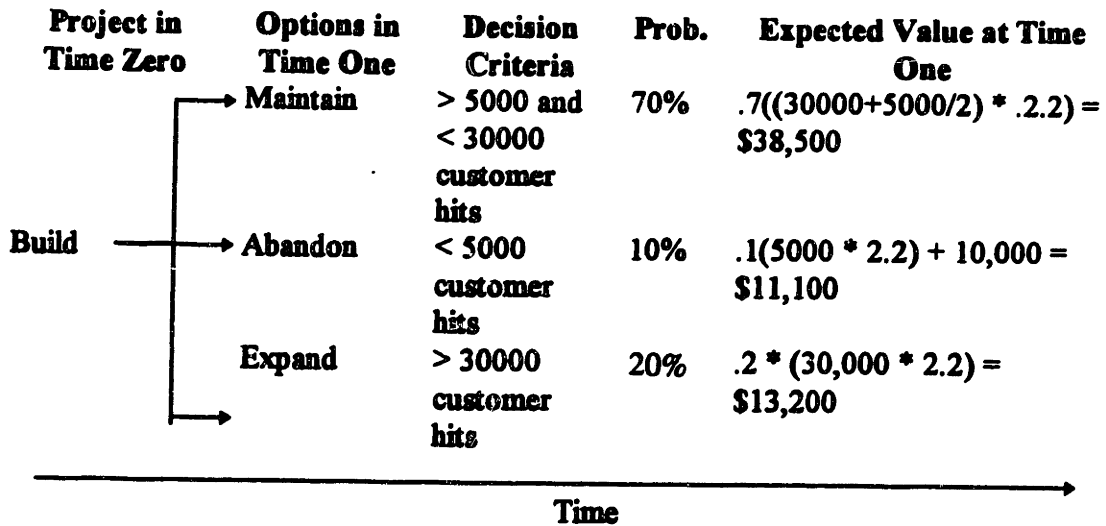
The formal application of option valuation is criticized by some as being too narrow and demanding to be applied practically to strategic decisions regarding investments in real assets (Kogut, 1994, p. 53). Brynjolfsson (1995) states that perhaps even more important than applying an options formula is for managers to remember that there are options and thus take steps to preserve them and create new ones.

Using decision tree analysis to consider future options may help in this regard. It can be applied to analyze investments in information technology. Consider the previous example.

The initial cost of developing the home page was estimated at \$100,000.

This project is a "pilot" project that represents a "real option" for developing a full scale interactive site in the future. To expand the site in the future and allow consumers to access their own data will cost an additional \$1 million. The firm is uncertain about the commercial viability of this option at the present time but expects that the future will provide additional information regarding demand for this service.

In the DCF example, the net present value of the project to build a web site was \$-65,004. In this example, possible follow-on options are considered. A decision tree helps illustrate the possible scenario:



The expected value of the options available after one year is:

$$38,500 + 11,100 + 13,200 = \$62,800$$

The decision tree is described below:

1. At time zero (T_0) the firm undertakes a project to develop a home page. Estimates of the benefits of the site are forecast based on displaced costs for providing customer support services which will now be automated. It is presumed that a percentage of customers who would call and request information via a call center will now use the web site to request the information. The cost savings is \$2.20 per customer contact.
2. At time one (T_1), after the web site has been established for a year, it is necessary to decide if further investment is warranted. At T_1 , the firm has at least three options:
 - expand the site (follow on)
 - perform only required maintenance (wait)
 - dismantle the site (salvage)

In this example, risk is reduced by developing the system in stages and deciding on next steps only after analyzing the results at the completion of the previous steps. For example, once the home page is available to consumers, the firm can extract data regarding the number of visits to the site. If demand for the site is high then perhaps expansion is a good investment. Additionally (or alternatively), the firm could survey visitors to the site regarding their preferences and use such data for expanding or redesigning the site.

The key point is that the firm has options, and the flexibility of having options has value. The firm can salvage the hardware, maintain, or expand the investment in the future. The expected value of building the home page is the sum of the expected value of all the available options, \$62,800. When we consider the options which are available at the end of the projects useful life, the value of the project increases.

Choosing a Valuation Method

When deciding what method to use it is useful to consider the following:



- Degree of complexity in forecasting the benefits. How easily can benefits be forecast? It may be useful to supplement quantitative analysis with some qualitative techniques to assist in communicating the value of intangible benefits.
- Overall cost of the project. Consider the expense of performing cost-benefit analysis against the relative investment the project requires.
- Degree of precision and quantification required. Rigorous cost-benefit analysis may be time-consuming and expensive to complete with a high degree of accuracy. The appropriateness of rigorous quantitative analysis may depend on the nature of the project. For example, projects involving

new technologies involve more risk and require may more consideration than straightforward upgrades to existing infrastructure.

In order to determine which of the valuation techniques described is appropriate for evaluating a specific information technology investment, it is useful to develop an investment profile. The investment profile is comprised of the following elements:

- **Cost profile** - The cost profile ranges from low to high depending on the amount of investment relative to the total capital expenditure of the firm. The cost component is important to consider when deciding how much time and money should go into an evaluation.
- **Benefit profile** - The benefit profile contains a rating of the investments impact on the areas described earlier: operational efficiency, competitive position, management control.

The following matrix depicts how each category of cost, ranging from high to low, can be compared with the relative expected level of benefit. The matrix is useful for determining which valuation technique is appropriate for a given investment.

		Cost Profile 		
		- Low	+ Medium	++ High
Increasing intangible benefits 	Benefit Profile	Cost/Benefit	Cost/Benefit, DCF	Cost/Benefit, DCF
	- Operational efficiency	Cost/Benefit	Cost/Benefit, Enhanced DCF	Cost/Benefit, Enhanced DCF
	+ Management Control	Cost/Benefit, Enhanced DCF	Cost/Benefit, Enhanced DCF, Options	Cost/Benefit, Enhanced DCF, Options
	++ Competitive position			

Generally, cost-benefit analysis is a useful tool for valuing information technology investments. The more uncertain the costs and benefits are, the more valuable techniques such as enhanced DCF and options are for supplementing cost-benefit analysis. The more uncertainty that is present, the more useful the addition of conceptual tools become.

There is no one technique that should be applied in every situation. Information technology investments should be considered in context and viewed by a firm individually. For example, a firm with the opportunity to increase the use of a large-scale fixed asset through an information technology investment, such as an ATM network, may behave differently than a firm with no related fixed asset. An investment profile for a project should contain industry- and company-specific characteristics. Then, one or more valuation techniques can be applied to provide guidance to the decision makers.

CHAPTER 4

HOW INFORMATION TECHNOLOGY INVESTMENTS ARE EVALUATED IN PRACTICE

This chapter explores how firms are making decisions regarding information technology investments in practice. In practice, firms appear to use the quantitative methods described in Chapter 3 for certain kinds of investments. More often than not, major investments in information technology are justified on the basis of "strategic intent" rather than projected return on investment.

Information Technology in the Banking Industry

Banks mediate a wide range of commercial and personal transactions involving the exchange and investment of money. While the banking industry has grown at a moderate rate over the last decade, the most significant changes have been in the structure of the industry. The result of a large number of mergers and acquisitions, the banking industry has become more "concentrated" (National Research Council, 1994).

Analysts attribute the consolidation of the banking industry to problems the industry experienced throughout the last decade. In the 1980s, the banking industry experienced economic and financial problems including losses from loans to less-developed countries, the savings and loan crisis, and the economic downturn of 1990 and 1991.

The information revolution has also had an impact on the banking industry. Nearly every product and service offered by the banking industry today requires sophisticated

information technology infrastructure. In the industry where the cliché "bankers' hours" was born, the information revolution has created an entirely new standard for delivering financial services to anyone, anywhere, at any time.

Information technology is both an enabler and driver of the consolidation in the industry. ATM technology has enabled a significant reduction in the need for bank branches. Increased economies of scale achieved by combining information technology operations is a driving factor in bank mergers (National Research Council, 1994).

Information technology has accounted for improvements in the quality of customer service and the availability of a wider array of banking services. Information technology has enabled financial service institutions to offer new products and services such as electronic funds transfers, automatic deposits, and direct debits payment processing. Currently, emphasis is on using information technology to increase the speed of data transmission, to eliminate non-essential paper trails, and to make banking and financial services available to consumers via the Internet (Clark, 1995).

The use of information technology has also changed the competitive environment of the banking industry. Due to relaxation of regulation in the industry, banks are facing increased competition. For the past two decades, banks have been losing market share to non-depository institutions that provide attractive funding alternatives to corporate and middle market companies. Technology is enabling non-depository institutions to mass market and deliver services direct to consumers without the use of banks as an intermediary. Banks are having to re-evaluate their revenue sources in light of a changing competitive environment (Clark, 1995).

Bankers are looking to information technology investments not only to lower costs but to transform their business. As a result, spending on information technology is expected to increase 20% from \$16.35 billion in 1994 to \$19.8 billion in 1997 (Panettieri, 1995).

A study conducted in 1995 by *The American Banker* and Anderson Consulting surveyed managers from 150 top banks to determine if line managers in the banking industry believe that information technology expenditures advance their business goals. They asked line managers: Does information technology make it easier for your bank to achieve its business objectives? The answer was "sometimes". The survey indicates that top-line managers question and undervalue the contributions of information technology because they believe that banks' information technology goals and spending generally do not align with business objectives.

Positive evaluations of information technology contribution occurred only when managers believed:

- the majority of information technology spending focused on top business objectives;
- the information technology strategy was of a "lasting" or "sustainable" sort; and
- the technology infrastructure was new.

The survey results show that retail bankers regard information technology as their "most important weapon" in winning and retaining consumers. The survey results reflect a shift in bank managers' expectations of what information technology can do from operational efficiency to strategic advantage.

Because information technology is playing a pivotal role in the banking industry, I selected the industry for further study. Principal managers of information technology in the banking industry were interviewed to provide an in-depth view of the decision-making process for justifying investments in information technology in their firms. These institutions were chosen based on well-publicized commitment to the use of information technology and/or their affiliation with MIT's International Financial Services Research Center.

Information technology managers were asked to describe the processes by which their firm justifies investments in information technology. The emphasis was on uncovering the process and rationale behind investment decisions rather than details regarding a specific investment. The primary interview questions are provided in Appendix A.

CITIBANK

Citibank was founded in 1812. It was a pioneer in offering corporate banking services overseas and was the first to offer personal loans in the 1920s. Since the 1920s, Citibank has focused on providing consumer banking and financial services worldwide. Citibank was one of the first banks to recognize that regardless of where a consumer resides, they have essentially the same needs for banking services. Citibank is known worldwide for providing consumer banking services.

John Reed, Citibank's Chief Executive Officer, is considered to have developed consumer banking markets into what they are today. Citibank was the first bank to deploy ATMs on a worldwide scale (Hoover, 1996). Citibank is the largest issuer of consumer credit cards, being the first to offer a VISA card with the security feature of the owner's photograph.

After dealing with "bad loans and management bloat" problems (Hoover, 1996) that surfaced in the early 1990s, Citibank is now focused on global consumer banking and financial services for large international companies and small businesses. Citibank has de-emphasized mortgage servicing and middle-market business banking services.

Information technology played a key role in Citibank's success in the consumer banking market. Citicorp's deployment of ATM networks around the world made their use the de facto standard cost of doing business for any firm in the consumer banking industry.

Citibank recently upgraded its communication systems and is entering the electronic banking age by offering home computer banking systems to consumers in New York, Chicago, and Washington (Hoover, 1996).

Information Technology Organization

Citibank's information technology function is decentralized among their various business units. It has two components: corporate function and business unit function. Each business unit (i.e., retail, global custody) has its own information technology group. There are two corporate functions: the Data Center Service that provides mainframe facilities, and the Corporate Technology Group (CTG) that monitors standards, advises business units, and performs high technology R&D. CTG has one person assigned to each business unit who is responsible for acting as a liaison. I discussed Citibank's information technology investment evaluation process with Dan Schutzer, a vice president in the Corporate Technology Group.

At Citibank, the process of setting the annual information technology budget is described as a zero-base budgeting process. Each business unit develops its own budget and these budgets are combined into an overall information technology budget. The 1995 information technology budget at Citibank is \$1.5 billion (Panettieri, 1995). Citibank employs 9,000 people in the information technology function. Control over how the budget is allocated remains within the business units.

Dan mentioned growing tension between CTG and the business units over the use of new technology. Dan's view is that the business units want to build systems using technology they understand and know (such as mainframe and COBOL, which have been the mainstays of technology for the last several decades). Yet, CTG is stressing the need to move to new technology platforms. In 1996, Citibank is planning to spend \$50 million to \$100 million on research and development of new technology.

Dan noted that Citibank has aggressively cut spending on the maintenance of existing mainframe systems in an effort to reduce dependence on these systems and move new functionality into front-end systems based on new technology. Dan described the "front-end first" strategy as a way to move away from legacy systems. Also, Citibank is pursuing a buy-versus-make strategy when it comes to new software applications. Standardized software applications sometimes have the effect of reducing risk and implementation time.

From the information technology perspective, Dan described the biggest challenges at Citibank as:

- training, re-training and staffing; and
- reducing the time required to react to change.

Dan described the need for information technology staff that is less operationally focused and more business-oriented. There is also a challenge for the business unit staff to become more knowledgeable about information technology, both from a "project management standpoint" (because the business units are generally responsible for managing their own information technology projects) and from a "leverage standpoint", in understanding and knowing how information technology can be used effectively.

Dan confided that projects are generally not tightly controlled and that estimated schedules and costs are almost always overrun. Information technology projects often overrun schedules by years. He noted that budgets are not questioned because the businesses unit managers do not know the right questions to ask. Citibank's human resource department is currently tasked with developing off-site training programs to help business unit managers become more familiar and comfortable with information technology. Dan also stressed that Citibank thinks it is important to provide the information technology training for business managers in a non-threatening environment where they will not be reluctant to ask basic questions.

The other challenge is reducing the time required to react to change without compromising quality. Dan stressed that while trying to reduce the time and money spent on projects, care must be taken with respect to quality control. Citibank deals with many retail customers who expect accuracy when it comes to accounting for their money and financial transactions.

Project Valuation

Dan described how Citibank records the business requirements and cost-benefit analysis associated with information technology projects in a document they call a "building pass". A building pass contains the following components:

- Description of the business requirement and justification. Ideas for new and enhanced systems originate in the individual business units. The requests are documented by a description of the required systems and how the systems will enhance the business operations.
- Forecast of the associated benefits. Every request contains a description of the expected benefits. Dan indicated that the benefits are usually described in terms of labor savings based on reduced data entry.
- Estimate of the cost to complete the project. Costs are determined based on level of effort necessary for completing the project and supporting the system over its projected lifecycle.

All projects must have a building pass. The building pass is completed in a combined effort by members of the business units, their associated information technology staff, and CTG. The level of rigor associated with the cost-benefit analysis component of the building pass varies depending on the nature of the project. Dan feels that requests for

enhancements to existing systems can be documented with a high degree of accuracy because the facts are known and therefore those making the request can specify cost and benefit data in detail. However, projects involving new technology and new products are less likely to contain an accurate picture of the costs and benefits. Dan stressed that the cost benefit analysis generally represents a "legitimate try" but "they can only use what they can predict and the results are considered unpredictable". Dan also indicated that predicted labor savings are rarely recognized once a project is approved. Actual staff reduction is rare; more commonly, the resources are simply reallocated.

Citibank, according to Dan, uses the payback period method for evaluating information technology projects. Each project is approved or disapproved by a steering committee based on when the cost will be recovered. Because of the decentralized nature of the organization, approval ultimately falls within the control of the business unit managers. Dan said that the business managers are likely to approve the projects they want to undertake regardless of the results of the cost-benefit analysis.

We discussed three separate projects. All three projects were eventually undertaken.

Dan described a check imaging project that was undertaken that had "hard numbers" for both costs and benefits. The project involved using document imaging software and hardware to record images of checks and eliminate the need for data entry. In this case, the costs could be clearly forecast and the benefits were calculated in terms of labor savings for data entry clerks.

Alternatively, a project was proposed to create a data warehouse. This project involved relocating data that had previously been stored on tape to a new storage medium which would provide for faster location and retrieval. The cost-benefit analysis contained only hard data regarding cost. There was not expected to be a great deal of savings in terms of operational efficiencies that could be used to offset the cost. There was no

attempt to quantify the intangible benefits. But, as Dan said, relevant decision makers felt the data warehouse was simply "the cost of remaining competitive".

In both of the above-mentioned cases, Citibank had benchmark numbers on comparable projects that their competitors had undertaken. Thus, Dan felt the costs of the projects could be forecast with a reasonable degree of accuracy.

A project involving a new derivative product was undertaken to remain current with the competition. For this project, neither costs or benefits could be forecast with a high degree of accuracy. Dan said again "a project like this is the cost of staying in business". This project involved new technology which adds uncertainty. With this type of new product, there were no industry benchmarks available.

The three projects described above range from reasonably forecastable costs and benefits to very uncertain costs and benefits. Projects with costs and benefits that are easily forecast, or projects where the related cost is below a minimum threshold, are often accepted and approved by business unit managers. Projects with a higher degree of uncertainty above a certain dollar threshold are elevated to higher levels of management for review. Projects of this nature are reviewed for strategic value and accepted or declined accordingly. Some projects go as high as John Reed for approval.

BANKERS TRUST

Bankers Trust was founded in 1903. Bankers Trust's original charter was managing trust business for commercial banks. However, in 1913, the Federal Reserve Act allowed all banks to offer trust services, thereby eliminating Bankers Trust's competitive edge. Bankers Trust began offering a variety of banking services both to the consumer and corporate sectors. Since the early 1980s Bankers Trust has focused on providing financial services to the corporate sector. Bankers Trust now specializes in using derivatives and other risk management strategies for its corporate clients.

Like Citibank, Bankers Trust faced difficulties in the early 1990s. Bankers Trust was hit hard by the devaluation of the Mexican peso in 1994 and the subsequent decline of its Latin American investments. Bankers Trust also experienced losses stemming from the decline of the U.S. bond market in 1994 and is now being sued by two long-time clients for alleged misconduct relating to the derivatives market (Hoover, 1995).

Bankers Trust focuses on three fundamental concepts for improving their performance in the future:

- cultivating long-term customer relationships;
- leveraging their expertise in risk management across product and geographical boundaries; and
- using innovation to adapt to a dynamic financial market.

Bankers Trust has a \$500 million information technology budget and employs 2,000 people in the information technology function. There are four components in this function: applications, telecommunications and data center services, technology strategy, and desktop support. I spoke with Anish Mathia, Managing Director of Technology Strategy.

Information Technology Organization

Anish noted that the information technology function of Bankers Trust is currently undergoing reorganization to make it centralized. Anish is of the opinion that the centralization of the Information Technology Department was motivated by top management's desire to make one person responsible for the information technology budget. The official motivations presented were cost control and increased coordination across lines of business.

At Bankers Trust the information technology budget is adjusted annually. A percentage increase or decrease is negotiated in light of the projects that need to be

undertaken and the current cost-cutting measures. The basis for the budget is an information technology strategy which defines the desired architecture and applications for a three-year time horizon. It is Anish's opinion that the *process* of developing an information technology strategy, negotiated between the business units and the senior technology people, is more important than the specific strategy itself. His feeling is that the strategy document could be burned once the process is over since both the risk management and information technology environments are so dynamic. But, Anish points out, negotiating the information technology strategy is a useful exercise for achieving a common understanding and management of current information technology issues.

Anish described the biggest challenges at Bankers Trust (from an information technology perspective) as

- "People"; and
- "Living up to expectations".

Anish described the people problem as one fostered by "technologists such as Negroponte, Gates, and even Al Gore, as well as internal technologists, who generate hype without substance." His point is that the hype surrounding information technology creates a credibility gap for those who are trying to implement realistic applications.

Valuation Process

Anish said that in his opinion, "information technology infrastructure in banking is a necessity". Basic information technology infrastructure for executing financial transactions, for complying with government regulation, for providing traders with access to the data they need to be effective, and for billing customers is considered by Anish to be "the cost of doing business". It is important to realize, however, that at Bankers Trust new product offerings are generally sophisticated derivative products for managing risk that require custom application software. The lead time for developing applications to

support these products is sometimes longer than the products themselves are viable.

Generally what Banker's Trust does is support a new product offering manually and prove commercial viability before building an information technology infrastructure to support the product.

The process for approving investments in information technology at Banker's Trust involves the following steps:

1. Definition of a business requirement by the operating department. The operating departments often seek assistance from individuals in information technology to define the technical functions and requirements.
2. Define the associated costs and benefits of the project again with input from information technology personnel. At Banker's Trust the benefits are usually defined in terms of forecasted savings or increased sales and transaction revenues associated with offering new products and services.
3. Determine the net present value of the project by applying the discounted cash flow technique using the forecasted costs and monetary benefits. The discount rate generally includes a return in addition to the cost of capital. The current discount rate at Bankers Trust is 22%.
4. Submit the above definition of business need and NPV to the information technology steering committee for approval.

However, not all projects must overcome a 22% hurdle rate. For example, infrastructure projects are considered "the cost of doing business" and not required to show a return. New business applications are subject to hurdle rate scrutiny. With most new business applications, Banker's Trust first attempts to justify the costs with benefits based on forecasted savings. If that is not enough, additional revenues are forecast that may

result from the completion of the project. Intangibles are considered when a project cannot overcome the hurdle rate but many times Anish says the approval decision simply depends on "how badly someone wants the project".

Anish said he is often on committees that review information technology investment projects. He claims to give little merit to the numbers presented in such committees. The first consideration he makes is simply how much money is involved and then, Anish says, it is a matter of "whether or not the project makes sense".

Anish is of the opinion that the emphasis on decision science and the forcing of quantitative analysis for information technology investments is strictly an American phenomenon. He believes that there is a place for "instinct in some of these matters". He sometimes prefers to view projects from an "upside/downside perspective". The downside is the cost of the project if it fails. The upside requires considering how much additional revenue Bankers Trust is likely to receive if the project is successful. If the risk seems reasonable, the project makes business sense, and the business unit can afford to pay for it, then he is likely to lend his approval.

Anish believes that Bankers Trust could do a better job of project management. He believes that project managers should be monitoring not only delivery of applications but also measuring the results of projects against forecasted market projections. Anish described how information technology projects at Bankers Trust "never really finish". Once a project is begun he says "it simply becomes work in process". He feels the need for tighter control over deadlines and implementation schedules. His experience is that when a project duration is greater than one year, or a forecasted budget is greater than approximately \$10 million, the forecasts become less accurate. He advocates all projects producing a production-ready deliverable within twelve months. He believes that such a policy may cost the firm more in the short term but, in the long run, the firm will save money and be more effective at getting systems in production in a timely fashion.

Anish stressed that the technical risk is very high given the dynamics of the computer and communications industries today. He advocates that all information technology investments be evaluated in terms of business value and "built to solve business problems" rather than "built around available technology". To him, the decision process for evaluating investments in information technology should involve:

- defining the business need; and
- determining a cost effective way to meet the need.

Anish does not believe that investments in information technology should be evaluated in the same manner as investments in financial securities. Anish said "in the financial industry information technology is the cost of doing business".

MYSTERY BANK AND TRUST

The third financial institution requested anonymity. It will be referred to as MB&T.

MB&T was established as the result of a merger of several predecessor banks in 1961. It is chartered to provide commercial banking services with a primary focus on servicing and managing financial assets for large institutional investors. MB&T combines a vast information technology infrastructure with banking, trust, investment management, and securities processing capabilities to support global investment strategies. MB&T has several very large pension funds as clients.

MB&T has successfully leveraged information technology to further the strategic goals of their business. MB&T's investment in information technology has been the subject of many articles in both the information technology and financial press. In the late 1980s, MB&T invested over \$100 million to develop a multi-currency asset management application.

In an interview with the Chief Information Officer (CIO) of MB&T he described how information technology links MB&T with their customers. The CIO described how all "internal and external interactions and functions of the business, and all products and services are aligned with the firms business strategy".

Information Technology Organization

MB&T's information technology function is centralized. The core business functions are organized in operating departments. MB&T has a technology steering committee comprised of information technology experts and various members of the operating departments. This steering committee meets monthly to discuss the use of technology and set direction.

The CIO described the most challenging aspect of his job as managing the pace of technological change. He described a "necessity for vigilance" in monitoring how the industry is changing and the possible implications for their information system architecture. His approach to date has been to "define a standard architecture profile by which all technological changes are measured against". In particular, he mentions chip speeds and network speeds as the kind of technology improvements that have significant implications possibly causing MB&T to radically change the way they operate.

Valuation Process

The CIO discussed the project justification process for two types of information technology projects that were undertaken in the recent past: a "strategic" project and a "leverage" project.

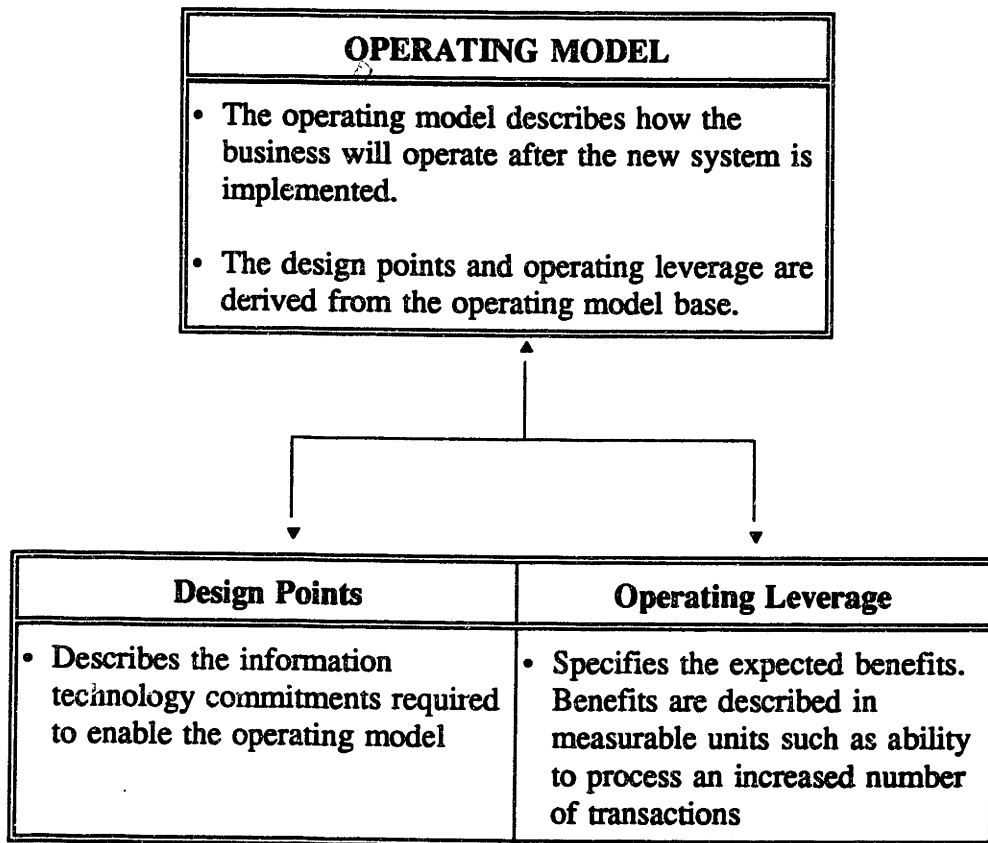
The CIO told how in the late 1980s, a "strategic" project was undertaken to develop a new flexible infrastructure for asset management. In 1987, MB&T was faced with long-term operating issues that required a "scale up" of existing applications to be able to handle increasingly complex investment products. MB&T researched what they needed to do to compete and discovered that their customers needed the bank to provide products and services which facilitated global investments. In 1987, the CIO developed a proposal to create a real-time multi-currency accounting system to replace their batch-oriented single currency accounting system. Despite what the CIO described as "widespread internal debate" the CEO approved a five-year project plan to develop a multi-currency Global Portfolio Accounting (GPA) system. The funding for the project was granted based on direct approval by the CEO without rigorous cost-benefit analysis. The CIO said that the GPA project was "conceived and approved based on a set of ideas about where to take the business". The CIO said, "With a strategy project like this, you cannot get hung up on creating cost benefit analysis based on phantom benefits whose value you can rarely get executives to agree on." The objective for GPA was to create a flexible environment for product design which would enable MB&T to expand market share in asset management.

The GPA project plan called for an investment of between \$50 million and \$100 million over a five-year period. The GPA project took over 500 staff years of effort and completed contains 20 million lines of code. An incremental approach was taken whereby additional funding was provided as each step was completed. The CIO noted that it probably cost more to complete the project incrementally than had it been done all at once, but each component was developed to stand alone. He would not estimate how much the cost increased under this approach. He stressed that "in this business, we cannot have even one day of down time". The result is that information technology development and implementation projects are accomplished in increments in order to mitigate and control the risk. He stressed that the information technology architectures must be accurate, on time, and perform without failure.

The new products that MB&T was able to offer because of GPA enabled them to secure significantly more new client accounts. Based on the multi-currency asset management functionality in the GPA application, MB&T won a contract to manage \$30 billion in assets for a large pension fund.

The CIO also described another type of project he called a "leverage" project. A leverage project is one that requires a new or changed information system to support changes in bank operations. This type of project is typical of daily operations at MB&T. The methodology that MB&T employs for valuing leverage projects was described by the CIO using the model depicted in Exhibit 4-1. The valuation process is performed in a joint effort between the operating departments and the Information Technology Department. The result of the process is a requirement document.

Exhibit 4-1
Model of MB&T valuation methodology



Project valuation methodology involves the following components:

- **The operating model describes the desired operations after the change or improvement, and how the business will function when the new system is implemented. The operating model is defined by the business managers or personnel who are requesting the desired changes. The process of creating the operating model forces the operating departments to define not only the required change but also to consider how the new systems will impact the existing business.**
- **The operating leverage defines the expected benefits that will be derived by implementing the operating model. The CIO stressed that operating leverage items (i.e., benefits) are defined and "owned" by the operating departments. It is the responsibility of the operating departments to define and measure the benefits of the project. In other words, the operating departments are responsible for forecasting the benefits and achieving the forecasted benefits once the project is complete.**
- **Design points describe the requirements of the change or enhancement. The design points document describes the responsibility of the information technology department.**

Standard NPV calculations are performed to evaluate leverage projects. Projects that do not exceed a return equal to the cost of capital are generally rejected. It is possible to obtain approval for such projects but only if significant business need can be demonstrated.

In the CIO's view this methodology ensures that all information technology projects are aligned with the business environment. In a final note, the CIO described "trust amongst the players" as a critical success factor of any information technology project. He

said that it is important for all the players to agree to make the systems work and not allow the environment to become "politicized".

Summary of Findings

The following table summarizes key finding from the interviews.

	Citibank	Banker's Trust	MB&T
Organizational structure	decentralized	centralized	centralized
Information technology budget	\$1.5 billion	\$500 million	unknown
Number of information technology employees	8,000	2,000	unknown
Valuation method	Payback	Net Present Value	Net Present Value
Discount rate	N/A	22%	Cost of Capital (approx. 12%)

Conclusions From the Interviews

Several fundamental conclusions can be drawn from the interviews:

- Funding for large information technology projects in these firms does not depend on quantitative cost-benefit analysis.

There is a clear distinction between projects for enhancements to existing systems that are relatively straightforward to value ex-ante, and projects which are considered to be strategic and difficult to value. The newer the technology and the systems, the more uncertain the future benefits and the less reliable quantitative analysis tends to be in the eyes of the information technology managers. Firms

rarely attempt to quantify benefits for strategic projects or, if they do, the numbers they come up with are looked at skeptically.

Two of the managers interviewed repeatedly expressed the view "information technology is the cost of doing business". Given the requirement to process large numbers of financial transactions and the competitive nature of the industry, large investments in information technology are not considered optional. In other words, investments in information technology have become a strategic necessity in the banking industry.

- Many in-house information technology development projects overrun schedules and budgets.

Two of these firms spoke about how common it is for information technology projects to overrun budgets and schedules and generally not meet the expectations that have been set. The repeated occurrence of overruns and delays leads to a credibility gap for the managers of the information technology function. Two of the managers advocate a phased approach with implementable deliverables at periods of no less than one year. The rapid pace of changing technology and business requirements are two common reasons cited for information technology projects to be approached incrementally.

As the banking industry has evolved and automation is expanded beyond basic transaction processing into customer care and risk management, banks are buying more shrink-wrap software (*American Banker*, 1994). This trend was confirmed at Citibank where Dan Schutzer said that they are pursuing a "buy-versus-make" strategy. Packaged software is usually less expensive than in-house development, proven in the marketplace, and faster to implement. In effect, some of the uncertainty associated with in-house custom development and implementation can be mitigated by purchasing standard software. However, differentiation is difficult

to achieve with standard software which can restrict new product offerings. Dan says that Citibank searches for standard software packages that meet its needs and will only undertake in-house custom development when necessary.

- Effective management of information technology projects involves individuals from both functional business operations and information technology.

Much of the success for achieving the link appears to be related to how organizations are structured and how information technology projects are conceived and managed. According to those interviewed, a good strategy makes the success of the project the shared responsibility of information technology managers and business functional managers. All managers said that it is essential that business managers feel responsible for the success or failure of the project. A common approach seems to make functional business managers responsible for forecasting the benefits and designing the measurement criteria by which the success or failure of the project will be determined. Additionally, it seems essential that information technology managers transcend the technical information technology environment and participate in the general management of the firm. This confirms that information technology is moving toward a more strategic rather than a cost reduction focus. The CIO is now a player at the "strategic table."

- The use of information technology is regarded by those interviewed as a key component in their future strategy.

Citibank is committed to providing consumer banking services worldwide. Citibank was a first mover when they introduced ATM technology and is continuing the trend by being one of the first to introduce home banking applications for consumers. MB&T recognized that the key to global asset management was the timely accurate movement of information and leveraged information technology to

create a information systems architecture that places them in a competitive position in that segment of the industry. Bankers Trust states that globalization and innovation through the use of information technology are key components of their business strategy for future growth. Each manager confirmed the need to link information technology with the overall business strategy as a key success factor.

- The level of uncertainty and risk associated with information technology investments is high.

Evaluation of investments in new technology was seen as a key challenge for all three information technology managers. In support of the importance of this effort, the Banker's Trust survey cites the newness of the information technology as a factor in its perceived level of benefit to the business managers. All three managers feel one of their greatest challenges is evaluating technological advancements and determining what it means to their firms. For example, the business of MB&T, asset management, is very transaction-intensive. It is critical for MB&T to offer the latest technology in order to maximize transaction accuracy and speed. Banker's Trust warned of a growing credibility gap between information technology staff and functional managers when the technology cannot deliver the "nirvana" the managers read about in *PC Week*. Citibank's CTG fights against funding for existing legacy systems to expedite the transition to new technology.

There is a need to view new technology not only for enhanced speed and capability but also determine how it could be applied to enhance the overall business model for the firm. This does require management skills that can link technical capability with business value. There is increasing pressure on information technology departments to not only support daily operations but to leverage information technology to transform business.

CHAPTER 5

CONCLUSIONS

The role of information technology in business has changed from one of automating support functions for greater operational efficiency to one where broader strategic benefits are sought. Merely purchasing desired hardware, software and communications capability is not enough to ensure the realization of value. Effective management of information technology investments is key to achieving the maximum possible benefit.

Effective management of information technology requires performing valuation analysis of potential projects before they are undertaken. The goal of evaluating an information technology investment is to be able to recommend that the project be undertaken with a certain degree of confidence that it will provide benefits in the future.

Theory versus Practice

In theory, one applies capital budgeting techniques to evaluate investments in information technology. Techniques such as return on investment and net present value (NPV) are valuable for evaluating the future value of an information technology investment to a firm. But theorists and practitioners agree that it is not reasonable to expect to quantify every benefit from information technology investments in monetary terms. Academic researchers are studying this issue and have developed several methods for evaluating the business value of intangible benefits and managerial flexibility. The effects of intangible benefits are difficult to predict with a high degree of accuracy, therefore it is suggested that the models described in Chapter 3 such as NPV gap, benefits

matrix, and real options, be applied to evaluate the potential effects. Academic researchers warn that ignoring intangible benefits because they are difficult to value, or assuming they have a zero value, may cause firms to undertake inappropriate projects and forego highly valuable projects.

In practice, information technology projects are viewed in two categories: operational and strategic. Operational projects are those that are required for daily operations where the costs and benefits are relatively easy to predict. Strategic projects are those which offer a wide range of future business-transforming benefits that are difficult to value in terms of today's business environment.

Operational projects are generally valued solely using NPV or payback techniques. Positive NPV or payback is usually accomplished by claiming labor savings that are rarely actually realized. However, during the interviews, several managers confided that in practice many projects that do not show positive NPV or payback are undertaken but without formal analysis of the intangible benefits. In practice, strategic projects are often approved on the basis of pursuing strategic direction without the benefit of formal valuation such as NPV. The benefits are considered too uncertain to merit such detailed analysis.

In practice, organizational structure can have an effect on the process as well. For example, at Citibank the decentralized structure allows for a great deal of discretionary spending. Bankers Trust is undergoing a period of centralization to put a limit on the type of spending and have one manager responsible for all information technology spending.

There was evidence that firms sometimes use unusually high hurdle rates to value information technology projects. Bankers Trust's use of a 22% hurdle rate biases the firm toward projects that offer high short-term gain and against projects with payoffs further in the future. This may simply be another way of curbing spending on information technology projects. Of course, it may have the effect of hurting them in the long run if

they do not invest in the key technologies that become future standards as the banking environment is undergoing rapid change.

Even though the firms do not use formal options valuation, it is important to note that several of the managers I spoke with advocate an incremental approach which informally places value on future flexibility and the ability to adapt to change. I believe that these concepts are intuitive to any experienced information technology manager but the formal methods are not applied in practice.

Two of the managers I spoke with readily admit that in practice many projects overrun budgets and time schedules and forecasted benefits are rarely measured ex-post. Clearly, the ability to forecast the costs and development timeframes is increasingly difficult in a rapidly changing technology and business environment. But the continued failure to meet deadlines, budgets, and expectations has created a credibility problem for the industry.

The results of the interviews show that in practice formal analysis is performed where hard numbers exist but stops short of full evaluation because of the difficult nature of measuring the far-reaching effects of information technology, from both a cost and benefit perspective. This raises two observations:

- If "intuition" regarding the intangibles were replaced with more formal up-front analysis, the likelihood of creating more accurate estimates and expectations would increase; and
- If post-project measurements of actual costs and actual realized benefits were performed and made available, the accuracy of future forecasting could be improved by using the data as benchmarks for future projects.

Summary

There is no one valuation technique that will apply in every situation. The use of more than one technique to evaluate a single investment may be useful for focusing on different aspects of the project. Investment guidelines and criteria must be customized by context, industry, and company-specific characteristics. Because information technology can leverage the unique assets of a firm to achieve competitive positioning in an industry by raising barriers to entry or creating service differentiation, these investments must be viewed by each firm individually. Even basic infrastructure investments to increase operational efficiency should be viewed in terms of business direction and future flexibility since the use of scalable systems will be more expensive in the short term but provide valuable options for growth in the future.

Investment evaluation is part of planning a project and setting expectations regarding cost and delivery of benefits. The process of valuing investments in information technology is not only being able to say "yes" or "no" with a greater degree of discrimination, but the process of evaluation and the resulting analysis can be a driving force behind a successful completion and implementation. The evaluation process provides an opportunity for information technology experts and business managers to develop a common understanding of what information technology can and cannot provide. Formalizing the process through the methods discussed in Chapter 3 can produce more accurate results and better understanding of the issues. The application of formal valuation methods can increase the likelihood of investing in highly successful projects that generate shareholder value in the future and assist in setting realistic expectations within the user community.

APPENDIX A

THE INTERVIEW GUIDE

1. What is your IT budget this year? What percentage increase/decrease from last year?
2. How many employees support your IT operations?
3. How important is IT to achieving the objectives in your business strategy? What role does IT play in the strategic goals?
4. What are the three most significant challenges facing you today?
5. What are the main reasons why your firm invests in information technology?
 - operational efficiency and reduced cost
 - quality
 - strategic positioning - value chain components - supplier/client relationships
 - increase timeliness and response time
 - employee satisfaction
 - competitive necessity
 - new technology
 - existing systems obsolete
 - End user utility - employees/customers
 - Competitive position - barriers to entry, new products
 - Management control
 - Increase financial performance
6. How has the use of IT influenced the organizational structure of your company? (i.e. levels of hierarchy, centralization, decentralization)
7. Has your company achieved a competitive advantage through the use in information technology?

If yes, how? (I.e. cost reduction, differentiation)
8. Does your firm have a formal IT Strategy?
9. What is the planning horizon?
10. What are the main components of the IT budget?
11. What IT related expenditure is treated as an operating expense vs. capital investment?
12. Describe the approval process for new IT investment?

13. Does the company perform pre-project cost/benefit analysis for IT investments?
If so, what methods are employed?
14. What are the benefit parameters?
15. Do you include intangible components such as increased customer or employee satisfaction?
If so, how do you assign a value?
16. What are the main cost parameters?
17. In your experience, have you found hidden costs in IT projects?
18. Have you ever had a project under budget and on-time. Which slip is more acceptable?
19. Does the difficulty of vigorous IT investment justification ever raise issues?
If so, what are they?
20. What rate of return is acceptable? (i.e., cost of capital versus marginal return)
21. What is your sense of security analysts reaction to the announcement of increased IT spending?
22. What are your views regarding user center design, development and deployment?
23. Do you measure the IT investments over time?
If so how? What do you measure? What do you do with the information?

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