Chapter

17 Information Technology Economics

Learning Objectives

After studying this chapter, you will be able to:

1. Identify the major aspects of the economics of information technology.
2. Explain and discuss the productivity paradox.
3. Describe approaches for evaluating IT investment and explain why it is difficult to do it.
4. Understand the nature of intangible benefits and the approaches to deal with such benefits.
5. List and briefly describe the traditional and modern methods of justifying IT investment.
6. Identify the advantages and disadvantages of approaches to charging end users for IT services (chargeback).
7. Understand and describe the IT justification process via examples.
8. Understand some major economic impacts of IT and EC.
9. Describe economic issues related to Web-based technologies including e-commerce.

Integrating *IT*

ACC


FIN


MKT

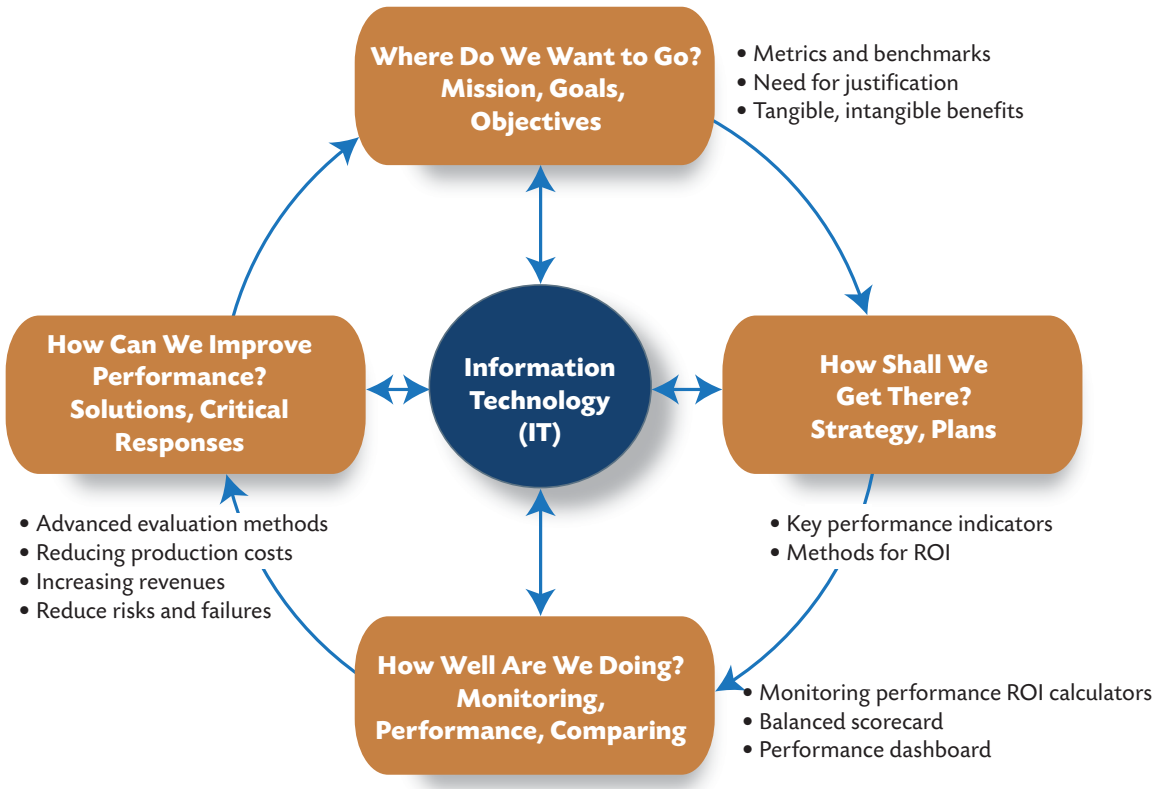

OM


HRM

IS

IT-PERFORMANCE MODEL

The focus of this chapter is on measuring and justifying IT investments and the benefits of their implementation. This is a critical step in our IT performance model. Unfortunately this is not easy to do, so many methods exist. The chapter also presents the economic aspects of IT that contribute to improved performance.



The business performance management cycle and IT model.

JUSTIFYING INVESTMENT IN IT AND EC AT CALIFORNIA STATE AUTOMOBILE ASSOCIATION

The Problem

California State Automobile Association (CSAA) is a 7,000-employee, not-for-profit organization serving residents across northern California, Nevada, and Utah. Focusing on membership, travel, and insurance, CSAA provides services for more than 5 million members and annually processes 3 billion documents and scans 1.6 million images.

To support its members and employees, CSAA had a major IT infrastructure based on 600 servers. However, these servers were 4.5 years old, vendors were no longer supporting their operating systems, there were security patches and outages, and disk failures and crashes were common. In short, the existing infrastructure was nearing its end of life. This created numerous problems, not to mention the inability to launch or improve emerging IT and e-commerce projects, such as automated members' self-service capabilities and enterprise-level customer service.

The Solution

To support existing and future IT applications, it was necessary to replace the 600 servers. The upgrading would reduce the number of servers to 136 for less maintenance and better utilization. Also, the solution would ensure CSAA received the latest security patches and antivirus updates for its 8,500 PCs. The solution also calls for innovations such as Web farms (or Web servers), which increase the capabilities of the individual servers.

Projected Costs and Benefits for the CSAA Infrastructure Proposal

Project Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Hardware	$5,000,000	$0	$0	$0	$0	$5,000,000
EDS Charge	$2,500,000	$0	$0	$0	$0	$2,500,000
Total Project Costs	**$7,500,000**	**$0**	**$0**	**$0**	**$0**	**$7,500,000**
Benefits	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Productivity	$270,000	$270,000	$270,000	$270,000	$270,000	$1,350,000
Cost Avoidance	$1,680,000	$1,680,000	$1,680,000	$1,680,000	$1,680,000	$8,400,000
Hardware Savings	$3,644,800	$3,644,800	$3,644,800	$3,644,800	$3,644,800	$18,224,000
Support Improvement	$1,795,200	$1,795,200	$1,795,200	$1,795,200	$1,795,200	$8,976,000
Total Benefits	**$7,390,000**	**$7,390,000**	**$7,390,000**	**$7,390,000**	**$7,390,000**	**$36,950,000**
Financial Analysis	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
Net Value	($110,000)	$7,390,000	$7,390,000	$7,390,000	$7,390,000	
Cumulative Net Value	($110,000)	$7,280,000	$14,670,000	$22,060,000	$29,450,000	
Net Present Value	$21,863,789					

CSAA developed a *business case* for the solution and its outsourcing. EDS, a large outsourcer, won the bid. The projected cost of the project was $5 million for hardware, and $2.5 million for EDS services. A five-year rate-of-investment (ROI) projection justified the project (see the attached spreadsheet calculations). This was part of the business case submitted to top management.

The Results

The results of the spreadsheet analysis indicate an extremely positive return on the investment. The required investment of $7.5 million would be paid back in just over 12 months. The total accumulated tangible realized net benefits of almost $29.5 million translates into almost $22 million NPV (based on a 9 percent interest rate). The computed ROI of 493 percent is extremely high, and it convinced management to approve the project. In addition to the financial results, CSAA can deliver better and faster customer service, reduce the *total cost of ownership* of its IT infrastructure, support the company's growth, and offer EC services, such as automated self-service capabilities. Finally, security and privacy protection improved dramatically. All of this made the 5 million members and the 7,000 employees much happier.

Sources: Compiled from *EDS.com* (2006a), *EDS.com* (2006b), and *scaa.com* (accessed August 2008).

Lessons Learned from This Case

The case illustrates a situation in which an organization needed to decide on upgrading and restructuring its IT infrastructure. Once the goals and the technical solution were specified, CSAA prepared a business case that was used both for conducting a bid among competing vendors and for getting the approval from top management. To justify the investment, CSAA used a five-year projection utilizing three traditional tools of justification: ROI, NPV, and payback period. While the justification included only measurable tangible benefits, the analysis recognized significant intangible benefits, such as improved customer service.

In this case there was no need to quantify the intangible benefits since the return of the tangible benefits was more than sufficient to justify the investment. Furthermore, several quantifiable results, such as total cost of operation (TCO) and improved response time, were excluded from the financial spreadsheet for the same reason. Finally, CSAA decided to outsource the upgrading project and concentrate on its core competency.

The previous concepts are the main topics described in this chapter. Other topics described are more advanced justification tools that can be used for more complex situations and for handling the intangible benefits and costs. The chapter also presents the topics of chargeback of IT expenses and the economics of IT.

17.1 Technology and Economic Trends and the Productivity Paradox

TECHNOLOGICAL AND FINANCIAL TRENDS

Information technology capabilities are advancing at a rapid rate, and this trend is likely to continue for the foreseeable future. Expanding power and declining costs enable new and more extensive applications of information technology, which makes it possible for organizations to improve their efficiency and effectiveness.

On the hardware side, capabilities are growing at an exponential rate. *Moore's law,* named for one of the founders of Intel Corp., postulated that the number of transistors, and thus the power, of an integrated circuit (now called computer chip) would double every year, while the cost remained the same. Moore later revised this estimate to a slightly less rapid pace: doubling every 18 to 24 months. Figure 17.1 illustrates Moore's law as it relates to the power of Intel chips, measured in transistors count per chip (on the right). Moore has also applied the law to the Web, electronic commerce, and supply chain management (see Moore, 1997). Others applied it, with slight modifications, to storage capability and networks.

Assuming the current rate of growth in computing power, organizations will have the opportunity to buy, for the same price, twice the processing power in $1\frac{1}{2}$ years, four times the power in 3 years, eight times the power in $4\frac{1}{2}$ years, and so forth. Another way of saying this is that the **price-to-performance ratio** will continue to decline exponentially. Limitations associated with current technologies could end this trend for silicon-based chips in 10 or 20 years (or possibly earlier), but new technologies will probably allow this phenomenal growth to continue. Advances in network technologies and storage, as compared to those in chip technology, are even more profound.

What does this growth in computing power mean in economic terms? First, most organizations will perform existing functions at decreasing costs over time and thus become more efficient. Second, creative organizations will find new uses for information technology—based on the improving price-to-performance ratio—and thus

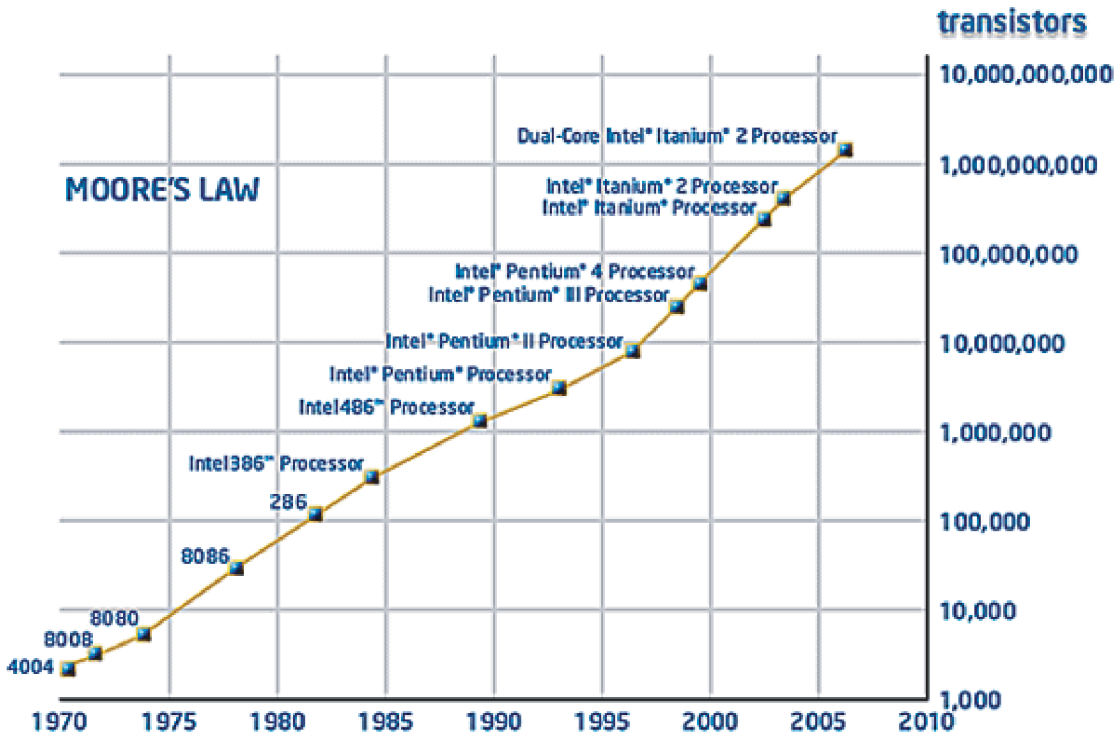


Figure 17.1 Moore's Law as it relates to Intel microprocessors. (*Source:* Modified from Intel Corporation, *intel.com.research/silicon/mooreslaw.htm*. Reprinted by permission of Intel Corporation, ©Intel Corporation.)

become more effective. They will also apply technology to activities that are technically feasible at current power levels but will not be economically feasible until costs are reduced. Information technology will become an even more significant factor in the production and distribution of almost every product and service. This will increase the attractiveness of automating more manual jobs. Will it also result in more unemployment?

ETHICS

These new and enhanced products and services will provide competitive advantage to organizations that have the creativity to exploit the increasing power of information technology. They will also provide major benefits to consumers, who will benefit from the greater product functionality and lower costs.

The remainder of this chapter focuses on the need for justifying IT investment, and evaluating the costs, benefits, and other economic aspects of information technology. Productivity is a major focus of economists, and those who studied the payoff from massive IT investments in the 1970s through the 1990s observed what has been called the *productivity paradox*. It is that topic we address next.

WHAT IS THE PRODUCTIVITY PARADOX?

Over the last 50 years, organizations have invested trillions of dollars in information technology. By the start of the twenty-first century, total worldwide *annual* spending on IT had surpassed two trillion dollars (ITAA, 2000). As this textbook has demonstrated, these expenditures have unquestionably transformed organizations: The technologies have become an integral aspect of almost every business process. The business and technology presses publish many "success stories" about major benefits from information technology projects at individual organizations or even industries (e.g., electronic airline ticketing). It seems self-evident that these investments must have increased productivity, not just in individual organizations, but throughout the economy.

On the other hand, it is very hard to demonstrate, at the level of a national economy, that the IT investments really have increased productivity. Most of the investment went into the service sector of the economy, which, during the 1970s and 1980s, was showing much lower productivity gains than manufacturing. Fisher (2001) reports on a study that showed that only 8 percent of total IT spending actually delivers value. Nobel prize winner in economics Robert Solow quipped, "We see computers everywhere except in the productivity statistics." The discrepancy between measures of investment in information technology and measures of output at the national level has been called the **productivity paradox** (see *en.wikipedia.org/wiki/Productivity_paradox*).

To understand this paradox, we first need to understand the concept of productivity. Economists define *productivity* as outputs divided by inputs. Outputs are calculated by multiplying units produced (for example, number of automobiles) by their average value. The resulting figure needs to be adjusted for price inflation and also for any changes in quality (such as increased safety or better gas mileage). If inputs are measured simply as hours of work, the resulting ratio of outputs to inputs is *labor productivity*. If other inputs—investments and materials—are included, the ratio is known as *multifactor productivity*.

EXPLAINING THE PRODUCTIVITY PARADOX

Economists have studied the productivity issue extensively in recent years and have developed a variety of possible explanations of the apparent paradox (e.g., see Olazabal, 2002). These explanations can be grouped into several categories: (1) problems with data or analyses hide productivity gains from IT, (2) gains from IT are offset by losses in other areas, and (3) IT productivity gains are offset by IT costs or losses. A summary is provided in Table 17.1.

CONCLUSION: DOES THE PRODUCTIVITY PARADOX MATTER?

The productivity-offsetting factors described earlier largely reflect problems with the administration of IT, rather than with the technologies themselves. In many cases these problems in administration are controllable through better planning or more effective management techniques. For organizations, the critical issue is not whether

TABLE 17.1 Possible Reasons for the Productivity Paradox

Reason	Explanation
Productivity gains are not shown in data or analysis.	Difficulties in defining or measuring benefits and productivity gains. Also, impact may be felt after a long time or in a secondary manner.
Productivity gains are offset by losses from the same IT in other areas.	Gain in one department or even in one company may result in loss in others (e.g., budget increase in IT may reduce marketing budget); or market share gain in one company may be a loss to others.
Productivity gains are offset by high costs.	Some IT projects cost too much (especially when total cost of operations is considered). Secondary impacts may cause losses.
Time lag may distort the picture.	IT investment today may be realized in profits years from now.
Actual use of IT system is different from what was envisioned.	For legal issues, labor considerations, or other reasons, systems are used differently than envisioned, yielding less performance than anticipated.

and how IT increases productivity *in the economy as a whole*, but how it improves their own productivity. Lin and Shao (2000) find a robust and consistent relationship between IT investment and efficiency, and they support evaluating IT investments in terms of organizational efficiency rather than productivity. For the results of a comprehensive study on the economic value of IT in Europe, see Legrenzi (2003).

Lucas (2005) divides the IT investment into infrastructure and applications. Then he identifies *direct impact*, such as direct cost savings, revenue generation, major organizational change, and partial success and failures. These may result in *second-order impact*, such as greater market share, strategic advantage, new or improved business processes, and better customer service. The second-order impacts may be very difficult to assess and may occur after a long time period.

Many believe that the productivity paradox as it relates to IT is no longer valid, since we are able to explain what caused it. Others believe that the issue is still very relevant, especially on the level of the economy as a whole. They claim that the paradox still matters because IT has failed to lift productivity growth throughout the economy, although it may have improved productivity at the level of firms or of industries. We may not at this point be able to provide a final answer to the question about whether the paradox still matters. The important conclusion that we can draw is that we need to be careful in measuring the economic contributions of IT on all three levels—firms, industries, and national economies. Because almost 50 percent of all capital investment in the United States is in IT and it is growing with time, it is even more important to properly assess its benefits and costs, and that is what this chapter is attempting to do.

The next three sections cover ways organizations can evaluate IT benefits and costs and thus target their IT development and acquisition toward systems that will best contribute to the achievement of organizational goals.

Review Questions

1. Describe Moore's Law.
2. Define productivity.
3. Describe the productivity paradox. Why is it important?
4. List three major explanations of the productivity paradox.

17.2 Evaluating IT Investments: Needs, Benefits, Issues, and Traditional Methods

Justifying an IT investment means comparing the costs of each project against its benefits in what is known as a **cost-benefit analysis.** To conduct such an analysis, it is necessary to define and measure the relevant IT benefits and costs. Cost-benefit analysis

is frequently assessed by *return of investment (ROI)*, which is also the name of a specific method for evaluating investments. Let's begin by looking at the reasons for justifying IT investments.

WHY JUSTIFY IT INVESTMENTS?

Companies need to justify their IT investments for a number of different reasons, the major of which are:

Increased Pressure for Financial Justification. Once upon a time, or so the story goes, the beggars of New York City decided to conduct a competition as to who could collect the most money in one day. Many innovative ideas were employed, and several beggars collected almost $1,000 each. The winner, however, collected $5 million. When asked how he did it, the beggar replied: "I made a sign that said 'EC experts need funding for an innovative electronic marketplace' and put the sign in front of the New York Stock Exchange."

This story symbolizes what happened from 1995 through 2000, when EC projects and start-up companies were funded, with little analysis of their business or financial viability. The result of the rush to invest was the 2001–2003 "dot-com bust," when hundreds of EC and IT start-ups went out of business and the stock market crashed. Some companies and individual investors lost over 90 to 100 percent of their investments! Furthermore, many companies, even large ones such as Disney, Merrill Lynch, and Sears terminated EC projects after losing considerable amounts of money and realizing few benefits from huge investments. The positive result of the crash was the "back-to-basics" movement, namely, a return to carefully checking and scrutinizing any request for any technology funding, namely, justifying IT and EC investments.

Today, companies are holding the line on IT budgets. According to Pisello (2004), IT executives feel the demand for financial justification and planning from executives, but most face an uphill battle to address this new accountability, as demonstrated by the following statistics in the IT field:

- Sixty-five percent of companies lack the knowledge or tools to do ROI calculations.
- Seventy-five percent have no formal processes or budgets in place for measuring ROI.
- Sixty-eight percent do not measure how projects coincide with promised benefits six months after completion.

At the same time, demand for expanding or initiating IT and e-business projects remains strong. In order to achieve the optimal level of investment, CIOs need to effectively communicate the value of proposed IT projects in order to gain approval, and this is what we teach you in this chapter.

Other Reasons Why IT Justification Is Needed. The following are some additional reasons for conducting IT justification:

- Companies now realize that IT is not necessarily the solution to all problems. Therefore, IT projects must *compete for funding and resources* with other internal and external projects. Analysis is needed to determine when funding of an IT project is appropriate.
- Some large companies, and many public organizations, mandate a formal evaluation of requests for funding (see the minicase, end of this chapter).
- A study finds that the day an IT investment is announced, the stock price of the company increases by 32 percent (per *CIO Insight*, news item, November 2007).
- Companies need to assess the success of IT projects after completion, and later on a periodic basis.
- The success of IT projects may be assessed in order to pay bonuses to those involved with the project.

Reasons for IT justification reported by *CIO Insight* (2004) are pressure from top management, internal competition for funding, the large amount of money involved, and weak business conditions. The same study found that justification forces IT into

better alignment with the corporate business strategy. Finally, justification increases the credibility of IT projects.

ISSUES IN IT JUSTIFICATION

While there is a clear need to justify many IT investments, there are several issues that need to be addressed. Two examples follow:

What Needs to Be Justified? When Should Justification Take Place? Not all IT investments need to be formally justified with a complex analysis. In some cases, a simple one-page qualitative justification will do. The following are cases where formal evaluation may not be needed:

- When the value of the investment is relatively small for the organization
- When the relevant data are not available, inaccurate, or too volatile
- When the IT project is mandated—that is, it must be done regardless of the costs and benefits involved

However, even when formal analysis is not required, an organization should have some qualitative analysis to explain the logic of investing in the IT project.

IT Investment Categories. A starting point to analyze IT investment is to distinguish between investment in infrastructure and investment in specific applications.

IT infrastructure provides the foundations for IT applications in the enterprise. Examples are a data center, networks, data warehouse, an IT security system, and a corporate knowledge base. *Infrastructure* investments are made to exist for a long time, and the infrastructure is *shared* by many applications throughout the enterprise (see Kumar, 2004). *IT applications* are specific systems and programs for achieving certain objectives—for example, providing a payroll or taking a customer's order. The number of IT applications is large and can be in one functional department or can be shared by several departments, which makes evaluation of their costs and benefits more complex (Peppard and Ward, 2005).

Other ways to look at IT investment categories are proposed by several researchers (e.g., Lucas, 2005). A major issue in dealing with IT justification is how to do it in light of some major difficulties.

DIFFICULTIES IN JUSTIFYING IT INVESTMENTS

Justifying IT projects can be a complex process, and therefore a difficult one. Let's see why.

The IT Justification Process. The IT justification process varies depending on the situation and the methods used, and it can be very complex, as shown in Figure 17.2. The figure shows the five areas that must be considered in the justification of IT projects. Thus, it may be difficult to conduct such a process.

Justifying large-scale investments is not only about selecting a justification method, but also about how to execute it. The appropriate process is not simple. The major steps of this process according to *Alinean.com* (2006) and *Baseline* (2006b) are:

- Lay an appropriate foundation for analysis, and then conduct your ROI.
- Conduct a good research on metrics (including internal and external metrics) and validate them.
- Justify, clarify, and document the costs and benefits assumptions.
- Document and verify all figures used in the calculation.
- Make figures as realistic as possible and include risk analysis.
- Do not leave out strategic benefits, including long-term ones. Is the project really bolstering the company's competitive and strategic advantage?
- Be careful not to underestimate costs and overestimate benefits (a tendency of many technology lovers).
- Commit all partners, including vendors and top management.

Now let's look at some specific difficulties in this process.

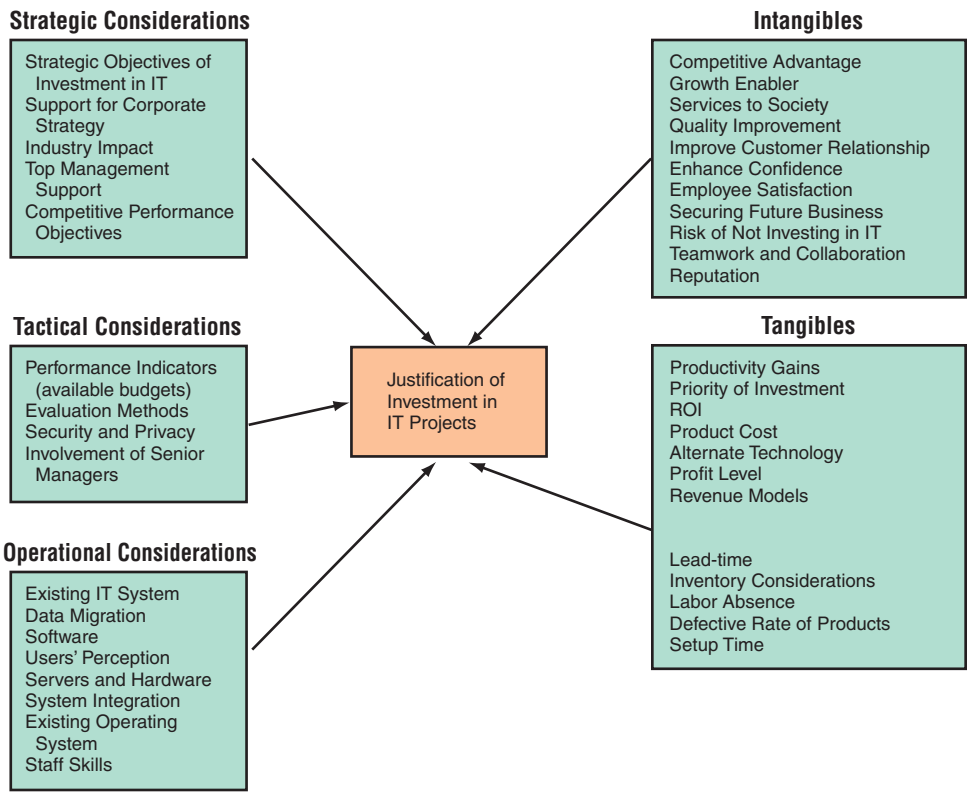


Figure 17.2 A model for investment justification in IT projects. (*Sources:* Gunasekaran et al. (2001), Misra (2006), and author's experiences.)

Difficulties in Measuring Productivity and Performance Gains. Productivity values may be difficult to measure, as was shown in Table 17.1 (pg. 617), and discussed by Conway (2007). Other difficulties in measuring productivity and performance levels are:

Incorrectly Defining What Is Measured. The results of any investment justification depend on what is actually measured. For example, to assess the benefits of IT investment, one should usually look at productivity improvement in the area where the IT project was installed. However, productivity increases and decreases may occur in other areas. Thus, the actual productivity may not be properly measured or even defined. The problem of definitions can be overcome by using appropriate metrics and key performance indicators.

Other Difficulties. A number of researchers have pointed out, for example, that time lags may throw off productivity measurements (Misra, 2006). Many IT investments, such as those in e-CRM, may take five to six years to show significant positive results, but many justification studies do not wait that long to measure productivity changes. For a list of other factors that impact performance, see Devaraj and Kohli (2002).

Relating IT Expenditures to Organizational Performance. Figure 17.3 illustrates some of the difficulties in finding the relationship between IT investment and organizational performance. The figure shows that the relationship between investment and performance is frequently *indirect*; factors such as shared IT assets and how they are used can impact organizational performance and make it difficult to assess the value of an IT investment. A major difficulty in justifying IT investment is the existence of substantial intangible benefits in addition to tangible ones.

The Problem of Intangible Benefits. Many IT projects generate **intangible benefits** such as faster time to market; employee, user, and customer satisfaction; easier distribution; greater organizational agility; and improved control. These are very desirable benefits, but it is difficult to place an accurate monetary value on them. For example, many people would agree that e-mail improves communications, but it is not at all clear how to measure the value of this improvement.

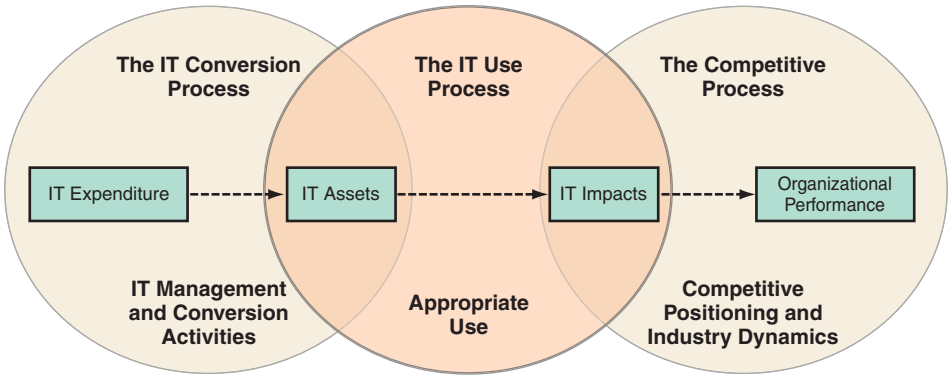


Figure 17.3 Process approach to IT organizational investment and impact. (*Source:* Soh and Markus, 1995.)

Intangible benefits can be very complex, yet substantial. They are common when knowledge workers are involved (per Conway, 2007). For example, according to Arno Penzias, a Nobel Laureate in physics, the New York Metropolitan Transit Authority (MTA) had not found the need to open another airport for almost two decades, even when traffic had tripled. This, according to his study, was due to productivity gains derived from improved IT systems (quoted by Devaraj and Kohli, 2002). IT systems added by the MTA played critical roles in ticket reservations, passenger and luggage check-in, crew assignment and scheduling, runway maintenance and management, and gate assignments. These improvements enabled MTA to cope with increased traffic without adding new facilities, saving hundreds of millions of dollars. Many similar examples of increased capacity exist. Intangible benefits are especially common in service and government applications (see Steyaert, 2004).

One class of intangible benefits, according to Ryan and Gates (2004), is *social subsystem issues*, such as comfort to employees, impact on the environment, changes in the power distribution in an organization, green IT, and invasion of the privacy of employees and customers.

An analyst could ignore intangible benefits, but doing so implies that their value is zero, and this may lead the organization to reject IT investments that could substantially increase revenues and profitability. Therefore, financial analyses need to consider not just tangible benefits but also intangible benefits in such a way that the decision reflects their potential impact. The question is how to do it.

Handling Intangible Benefits. One straightforward solution to the problem of evaluating intangible benefits in cost-benefit analysis is to make *rough estimates* of monetary values for all intangible benefits, and then conduct a financial analysis, such as ROI, on both the tangible and the intangible benefits. The simplicity of this approach is attractive, but in many cases the assumptions used in these estimates are debatable. If a technology is acquired because decision makers assigned too high a value to intangible benefits, the organization could find that it has wasted some valuable resources. On the other hand, if the valuation of intangible benefits is too low, the organization might reject the investment and then find that it is losing market share to competitors who did implement the technology.

There are many other approaches to handling intangibles (e.g., see Hubbard, 2007). Sawhney (2002) suggests the following solutions:

- **Think broadly and softly.** Supplement hard financial metrics with soft ones that may be more strategic in nature and may be important leading indicators of financial outcomes. Measures such as customer and partner satisfaction, customer loyalty, response time to competitive actions, and improved responsiveness are examples of soft measures. Subjective measures can be objective if used consistently over time. For instance, customer satisfaction measured consistently on a five-point scale can be an objective basis for measuring the performance of customer-facing initiatives.

- **Pay your freight first.** Think carefully about short-term benefits that can "pay the freight" for the initial investment in the project. For example, a telecom company found that it could justify its investment in data warehousing based on the cost savings from data mart consolidation, even though the real payoffs from the project would come later from increased cross-selling opportunities.
- **Follow the unanticipated.** Keep an open mind about where the payoff from IT projects may come from, and follow opportunities that present themselves. For example, Eli Lilly & Co. created a Web site called InnoCentive (*innocentive.com*) to attract scientists to solve corporate problems in return for financial rewards ("bounties"). In the process, Lilly established contact with 8,000 nonemployees but exceptional scientists, and Lilly's HR department has used this list of contacts for recruiting.

Benefits are only one aspect of cost-benefit (or benefit/cost) analysis. Cost, opportunities, and risks are the other elements.

Despite the difficulties in dealing with intangible benefits, IT justification is done by using traditional financial ROI analysis by many organizations. For more, see Hubbard (2007).

COSTING IT INVESTMENT

Placing a dollar value on the cost of IT investments may not be as simple as it may sound. One of the major issues is to allocate fixed costs among several IT projects. *Fixed costs* are those costs that remain the same in total regardless of change in the activity level. For IT, fixed costs include infrastructure cost, cost of IT services, and IT management cost. For example, the salary of the IT director is fixed, and adding one more application will not change it.

Another area of concern is the fact that the cost of a system does not end when the system is installed. Costs for keeping it running, dealing with bugs, and for improving and changing the system may continue for some time. Such costs can accumulate over many years, and sometimes they are not even anticipated when the investment is made. An example is the cost of the Y2K (the year 2000, when we moved to a new century and millennium) reprogramming projects that cost billions of dollars to organizations worldwide. An important issue is costing IT investments transaction costs.

Transaction Costs. **Transaction costs** cover a wide range of costs that are associated with the distribution (sale) and/or exchange of products and services (see *en.wikipedia.org/wiki/Transaction_cost*). Most economists (e.g., Chen, 2005) divide these costs into the following five categories:

1. **Search costs.** Buyers and sellers incur costs in locating each other and locating specific products and services.
2. **Information costs.** For buyers, this includes costs related to learning about the products and services of sellers and the basis for their cost, profit margins, and quality. For sellers, this includes costs related to learning about the legitimacy, financial condition, and needs of the buyer, which may lead to a higher or lower price.
3. **Negotiation costs.** Buyers and sellers need to agree on the terms of the sale (e.g., quantity, quality, shipments, financing, etc.). Negotiation costs result from meetings, communication-related expenses, exchanges of technical data and/or brochures, entertainment, and legal costs.
4. **Decision costs.** For buyers, decision costs result from the evaluation of sellers and their internal processes, such as purchasing approval, to ensure that they meet the buyers' policies. For sellers, decision costs arise in the determination of whether to sell to one buyer instead of another buyer, or not at all.
5. **Monitoring costs.** Buyers and sellers need to ensure that the goods and/or services purchased translate into the goods and services exchanged. In addition, they need to make sure that the exchange proceeds according to the terms under which the sale was made.

Using IT may reduce transactions cost, especially with EC and Web applications. However, it may be difficult to assess these costs.

OPPORTUNITIES, REVENUE GENERATED, AND RISKS RELATED TO IT INVESTMENT

Another major difficulty in assessing IT value is measuring possible benefits (tangible and intangible) that drive IT investment (see Peppard and Ward, 2005 and Tillquist and Rogers, 2005). Furthermore, some benefits are opportunities that may or may not materialize, so there is only a certain probability for return on the IT investment. In most cases in assessing benefits it is necessary to examine the revenues generated.

Revenue Models. In preparing the business case for IT investment, as will be described in Section 7.3, one should examine potential additional revenues. This is usually referred to as *revenue models*. Listed below are typical revenue models generated by IT and the Web:

- **Sales.** Companies generate additional revenue from selling merchandise or services over their Web sites. An example is when Wal-Mart or Godiva sells a product online.
- **Transaction fees.** A company receives a commission based on the volume of transactions made. IT increases this value. Transaction fees may be a fixed value per month. Alternatively, transaction fees can be levied *per transaction*. With online stock trades, for example, there is usually a fixed fee per trade, regardless of the volume.
- **Subscription fees.** Customers pay a fixed amount, usually monthly, to get some type of service. An example would be the access fee for AOL or Verizon. Thus, AOL's primary revenue model is subscription (fixed monthly payments).
- **Advertising fees.** Companies charge others for allowing them to place a banner on their sites.
- **Affiliate fees.** Companies receive commissions for referring customers to others' Web sites.
- **Other revenue sources.** Some companies allow people to play games for a fee or watch a sports competition in real time for a fee (e.g., see *espn.com*).
- **Other ways to increase revenues.** Straub (2004) suggests other ways that IT, and especially EC, can be used to increase revenues:
  - Increased revenues via products or services from a larger global market because of more effective product marketing on the Web
  - Increased margins attained by using processes with lower internal cost (e.g., using lower-cost computers) and from higher prices because of value-added services to the customer (e.g., information attached to product)
  - Increased revenues as a consequence of becoming an online portal
  - Value-added content sold from selling searches, access to data, and electronic documents

The Impact of Risk. Another potential benefit is that IT can be used to decrease risk to companies by providing them with timely information. Also, the risk to customers may be reduced. For example, organizations can increase the value of their products or services by using the unique capabilities of IT to reduce risks to consumers, such as those involving psychological relationships, quality concerns, delays, and financial transactions (see Kambil, 2001).

Psychological risks also can be reduced by allowing the customers to use an EC-based calculator and avoid potentially embarrassing situations. For example, online tracking tools reduce risk by allowing customers to check the status of a package. By publishing specifications and providing product comparison engines, EC can help reduce a customer's risk of purchasing an unwanted product or one of poor quality. EC also has been instrumental in providing customers with an accurate picture of product availability, helping them avoid the risk of unexpected delays. EC also can

mitigate customer concerns over the security of EC transactions. Finally, customer concerns over privacy and security can be addressed by linking the transaction to third-party security providers such as the Better Business Bureau or VeriSign. On the other hand, IT may introduce risks, such as security risks.

EVALUATING IT INVESTMENT BY TRADITIONAL COST-BENEFIT ANALYSIS OR ROI

Automation of business processes is a major area where it is necessary to define and measure IT benefits and costs. For example, automation was implemented in the organization's business offices when word processing replaced typing and spreadsheet programs replaced column-ruled accounting pads and 10-key calculators. In the factory, robots weld and paint automobiles on assembly lines. In the warehouse, incoming items are recorded by RFID readers. Another example is replacement of an old information system by a new or improved one. The decision of whether to automate is an example of a *capital investment* decision. Traditional tools used to evaluate investment decisions are net present value, internal rate of return, and payback period, which are known collectively as ROI. (For more details see *Online Brief 17.1* and Saibeni, 2008).

Return on Investment. The most common traditional tool for evaluating capital investments is *return on investment* (ROI), which measures the effectiveness of management in generating profits with its available assets (see Anonymous, 2004). The ROI measure is a percentage (and the higher this percentage return, the better). It is calculated essentially by dividing net annual income attributable to a project by the cost of the assets invested in the project. For an overview, see *en.wikipedia.org/wiki/Return_on_investment*. An example of a detailed study of the ROI of a portal, commissioned by Plumtree Software and executed by META group (now partners of Gartner), can be found at *plumtree.com* (also white papers at *metagroup.com*). Davamanirajan et al. (2002) found an average 10 percent annual rate of return on investment in IT projects in the financial services sector. The following tools are the most commonly used in ROI studies.

Using NPV. *Cost-benefit analysis* compares the total value of the benefits with the associated costs. Organizations often use *net present value* (NPV) calculations for cost-benefit analyses. In an NPV analysis, analysts convert future values of benefits to their present-value equivalent. They then can compare the present value of the future benefits to the costs required to achieve those benefits, in order to determine whether the benefits exceed the costs. (For more specific guidelines and decision criteria on how NPV analysis works, consult financial management textbooks.)

Formulas for NPV Analysis.

$$\text{PV} = \frac{1}{(1 - i)^r},$$

where n = number of years and i = interest rate for investment (cost of capital). It is also known as the *discount rate*. The PV factor is then multiplied by the future amounts to figure its value today, and compared with the discounted cost over the same periods, to compute the NPV.

$$\text{NPV} = \sum_{t=1}^{T} \frac{A_t}{(1 + i)^t} - C,$$

where

- t = specific year: 1, 2, etc
- T = project life, e.g., 5 years, 10 years
- i = interest rate (discount rate)
- A = income at period t
- C = initial investment, or PV of all investments over T

The NPV analysis works well in situations where the costs and benefits are well defined or "tangible," so that it is not difficult to convert them into monetary values. For example, if human welders are replaced by robots that produce work of comparable quality, the benefits are the labor cost savings over the usable life of the robots. Costs include the capital investment to purchase and install the robots, plus the operating and maintenance costs.

A project with an estimated NPV greater than zero may be a candidate for acceptance. One with an estimated NPV less than zero would probably be rejected. Of course, one needs to consider the nonfinancial intangible benefits, as discussed earlier.

Internal Rate of Return (IRR). If you have an investment that produces a number of cash flows over time, the *internal rate of return* (IRR) which is defined to be the discount rate that makes the NPV of those cash flows equal to zero, can be used. Some companies set a minimum acceptable IRR (or hurdle rate) based on their own cost of capital and the minimum percentage return they'd like to see from their investments.

Payback Period. The payback period is the point at which the yearly benefits of a project equal the costs.

Comparing the Methods. All of the above methods are useful, but not in all cases. The advantages and disadvantages of each (and some other traditional methods) are provided in Table 17.2.

Traditional Methods: Conclusions. This section has shown that several traditional methods can be used to assess the value of IT information and IT investment. However, traditional methods may not be useful for assessing some of the newest IT technologies. Therefore, there are some advanced methodologies for dealing with such investments in IT. We address some of these methods in Section 17.3.

Review Questions

1. Describe the reasons for financial justification of IT investments.
2. List some nonfinancial reasons for IT justification.
3. List and discuss the major difficulties in assessing IT investments.
4. Describe the issue of intangible benefits and some solutions used to evaluate them.
5. List some IT costing issues.
6. List four revenue models.
7. Define ROI, NVP, IRR, and payback period.

TABLE 17.2 Evaluating EC and IT Traditional Investment Methods

Method	Advantages	Disadvantages
Internal rate of return (IRR)	Brings all projects to common footing. Conceptually familiar.	Assumes reinvestment at same rate. Can have multiple roots. No assumed discount rate.
Net present value (NPV) or net worth (NW)	Very common. Maximizes value for unconstrained project selection.	Difficult to compare projects of unequal lives or sizes.
Payback period	May be discounted or nondiscounted. Measure of exposure.	Ignores flows after payback is reached. Assumes standard project cash flow profile.
Benefit-to-cost analysis or ratio	Conceptually familiar. Brings all projects to common footing.	May be difficult to classify outlays as expenses or investments.
Economic value added	Measures net value created for the stakeholder.	The true benefits can be difficult to measure.

17.3 Advanced Methods for Justifying IT Investment and Using IT Metrics

A comprehensive list of over 60 different justification methods for IT investments can be found in Renkema (2000). For details of some methods, see McKay and Marshall (2004). The methods are generally categorized into the following four types:

1. **Financial approach.** These methods consider only impacts that can be monetary-valued. They focus on incoming and outgoing cash flows as a result of the investment made. Net present value and return on investment are examples of financial-approach methods (described earlier).
2. **Multicriteria approach.** These methods consider both financial impacts and non-financial impacts that cannot be (or cannot easily be) expressed in monetary terms. These methods employ quantitative and qualitative decision-making techniques. *Information economics* and *value analysis* are examples.
3. **Ratio approach.** These methods use several ratios (e.g., IT expenditures vs. total turnover) to assist in IT investment evaluation.
4. **Portfolio approach.** These methods apply portfolios (or grids) to plot several investment proposals against decision-making criteria. The portfolio methods are more informative compared to multicriteria methods and generally use fewer evaluation criteria.

In the following section we describe some of the advanced methods.

Table 17.3 lists specific methods that are particularly useful in evaluating IT investment. Discussed in this section are the business case, the total cost of ownership, and the use of benchmarks. The rest are described in *Online Brief 17.2*. Other methods are cited briefly at the end of the section.

Unfortunately, none of these methods is perfect or universal. Therefore, one needs to look at the advantages and disadvantages of each, which vary according to the specific situation.

The Business Case Approach. A common method used to justify investments in large IT projects, or even in entire new companies, is referred to as the *business case approach*.

A **business case** is a written document that is used by managers to garner funding for one or more specific applications or projects. Its major emphasis is the justification of specific required investments, but it also provides the bridge between an initial IT plan and its execution. Its purpose is not only to get approval and funding, but also to provide the foundation for tactical decision making and technology risk management. A business case is usually conducted in existing organizations that want to embark on new IT projects (for example, an e-procurement project). The business case helps to clarify how the organization will use its resources in the best way to accomplish the IT strategy. Software for preparing a business case for IT (and for EC in particular) is commercially available (e.g., from *paloalto.com* and from *bplans.com*).

Sometimes an IT project is necessary in order for the organization to stay in business, and in those instances, the business case is very simple: "We must do it, we have no choice." Sometimes an organization must invest because its competitors have done so, and if it does not follow, it will lose customers. Examples are e-banking and some CRM services. These types of investments do not require firms to do a lot of analysis.

For a description of business cases in e-commerce, see Turban et al. (2008). For a tool for building a business case, see Wang and Shiang (2002) and *sap.com/solutions/pdf/IDC_Case.pdf*. For a discussion of how to conduct a business case for global expansion, see DePalma (2001).

Total Cost of Ownership. An important approach to IT cost evaluation is the **total cost of ownership (TCO)**. TCO is a formula for calculating the cost of owning, oper-

TABLE 17.3 Advanced Methods for Evaluating IT Investments

- **Business case.** This is a process of creating a document for justifying an IT investment, including funding an entire IT company.
- **Total cost (and benefits) of ownership.** This approach calculates the total cost over the lifetime of a specific IT system, hardware, or project.
- **Benchmarks.** This method is appropriate for evaluating EC infrastructure. Using industry standards, for example, the organization can determine what the industry is spending on e-CRM. Then the organization can decide how much it should spend. Benchmarks may be industry metrics or best practices recommended by professional associations or consultants.
- **Value analysis.** With the value analysis method, the organization evaluates intangible benefits using a low-cost, trial EC system before deciding whether to commit to a larger investment in a complete system.
- **Information economics.** Using the idea of critical success factors, this method focuses on key organizational objectives and potential impacts of the proposed EC project on those objectives.
- **Scoring methodology.** This method assigns weights and scores to various aspects of the evaluated project and then calculates a total score. Information economics methods are used to determine the aspects to be included in the scoring.
- **Management by maxim.** An organization may use this method to determine how much it should invest in large EC (and IT) infrastructures. It is basically a combination of brainstorming and consensus-reaching methodologies.
- **Real-options valuation.** This is a fairly complex assessment method, and used only infrequently. It can be fairly accurate in certain situations. The idea behind this method is to look at future opportunities that may result from the EC investment and then place monetary values on them.
- **Balanced scorecard.** This method evaluates the health or performance of the organization by looking at a broad set of factors, not just financial ones. It is becoming a popular tool for assessing EC projects (see Chapter 12).
- **Performance dashboard.** This is a variant of the balanced scorecard that is widely used in e-business situations. A dashboard is a single view that provides the status of multiple metrics (see Chapter 12 and *idashboards.com*).
- **Activity-based costing.** This managerial accounting concept was adapted for assessing EC investments in recent years and has been proven to be fairly successful.

ating, and controlling an IT system, even one as simple as a PC, over its life cycle. The cost includes *acquisition cost* (hardware and software), *operations cost* (maintenance, training, operations, evaluation, technical support, installation, downtime, auditing, virus damage, and power consumption), and *control cost* (standardization, security, and central services). The TCO can be a hundred percent higher than just the cost of the hardware, especially for PCs. By identifying these various costs, organizations can make more accurate cost-benefit analyses. A methodology for calculating TCO is offered by Bothama (2006). Examples of the items to be included in the TCO calculations are provided in Table 17.4.

A concept similar to TCO is **total benefits of ownership (TBO)**. These benefits cover both tangible and intangible benefits. By calculating and comparing both TCO and TBO, one can compute the payoff of an IT investment [Payoff = TBO − TCO]. For details on the calculations, see Devaraj and Kohli (2002) and *nucleusresearch.com*.

Assessing Investments in IT Infrastructure and Using Benchmarking. Information systems projects are usually not stand-alone applications. In most cases they depend for support on enabling infrastructures already installed in the organization. These infrastructure technologies include mainframe computers, operating systems, networks, database management systems, utility programs, development tools, and more. Since many of the infrastructure benefits are intangible and are spread over many different present and future applications, it is hard to estimate their value or to evaluate the desirability of enhancements or upgrades. In other words, it is much more difficult to evaluate infrastructure investment decisions than investments in specific information systems application projects. One method is the use of benchmarks, described next. For a framework for assessing IT infrastructure, see Kumar (2004).

Using Benchmarks to Assess Infrastructure Investments. This approach focuses on *objective* measures of performance known as **benchmarks** (see *en.wikipedia.*

TABLE 17.4 Examples of TCO Cost Factors

Cost Category	Cost Factor	Examples
Acquisition costs	Hardware	Monitors, CPUs, servers.
	Software	Operating systems, database management systems, word processors.
Control costs	Centralization	Specialized hardware (such as intelligent self-monitoring components that notify a network management console when a problem occurs) and software (such as directory services and desktop management interfaces) are needed to implement and maintain a centralized system. Support staff has to be trained to use these systems.
	Standardization	Initially, nonstandard hardware and software may have to be replaced by hardware and software conforming to the selected standards. Users may have to be retrained on the standard software, and the standard hardware may be more expensive than nonstandard hardware.
Operations costs	Support	Either in-house staff or a support contract is required to address hardware and software problems as they arise.
	Evaluation	New/upgraded versions of applications, operating systems, and hardware are constantly being released. Before new hardware or software is installed, it must be evaluated to determine: Does it do what it is supposed to do? And is it compatible with the existing IT environment?
	Installation/upgrade	After a new technology is evaluated, it must be installed and upgraded. Hardware and software upgrades are often related; new software generally requires more powerful hardware, forcing hardware upgrades.
	Training	Training allows end users to get the most from their workstations. Training can take two forms: formal training in a classroom setting and self-training as end users learn how to work new applications. Software and hardware installations/upgrades generally require some retraining of the end-user population.
	Downtime	Downtime arises not only when software or hardware failures occur, but also when software or hardware installations/upgrades occur. When a system fails, the organization incurs costs for the nonworking system, the nonworking employee(s), and whatever repairs are necessary to make the system functional again.
	Futz	Bill Kirwin of GartnerGroup defines the "futz factor" as "using corporate technology for your own personal use." This cost lies not in the system itself (it is already purchased) but in the time employees spend using the system for nonwork-related activities.
	Auditing	This is the cost of keeping track of an organization's technology assets. Computers move around a lot, especially in large corporations. To determine which department has which asset, some type of record keeping is required.
	Virus	Viruses increase a computer's TCO in two ways: they can destroy important data expensive to recreate, and they can cause a computer to crash completely, resulting in downtime.
	Power consumption	Published estimates put electric power consumption at $240 per year per workstation. In addition, computers generate heat, which can increase air-conditioning costs.

Source: David et al. (2002), p. 102.

org/wiki/Benchmark). These measures are often available from trade associations within an industry or from consulting firms. A comparison of measures of performance or of an organization's expenditures with the averages for the industry, or comparisons with values of the most efficient performers in the industry indicate how well the organization is using its infrastructure. If performance is below standard, corrective action is indicated. The benchmark approach implicitly assumes that IT infrastructure investments are justified if they are managed efficiently.

OTHER METHODS AND TOOLS

Several other methods exist for evaluating IT investment. For example, most large vendors provide proprietary *calculators for ROI*. However, these may be biased, so users must be careful in their use. To make the decision less biased, some companies use a third-party evaluator such as IDC (*idc.com*) to conduct ROI studies. An example of such a calculator is SAP Business Case Builder. (For details, see *sap.com/solutions/pdf/IDC_Case.pdf*.) *CIO.com* (2008) offers many tools via Nucleus Research Inc. for calculating ROI of different IT systems. Finally, *baselinemag.com* offers a wide range of calculators for Excel.

According to Rubin (2003), every IT project *must* be tied to a specific business objective, with its priority indicated, so as to measure the project's success in terms of a specific primary business value. Rubin developed a special "whiteboard" that includes metrics and their stakeholders. For details and examples, see Rubin (2003).

Some other methods are described briefly next.

Activity-Based Costing. A fairly recent approach for assessing IT investment is proposed by Peacock and Tanniru (2005), who suggest use of the *activity-based costing (ABC)* approach to assist in IT investment analysis. (For details on how ABC works, see a management or managerial accounting textbook and *en.wikipedia.org/wiki/Activitybased_costing*.) Using a case study, Gerlach et al. (2002) showed that the company that utilized ABC derived significant benefits from a better understanding of IT delivery costs and a rationale for explaining IT costs to department managers. Mutual understanding of IT costs is a necessary condition for shared responsibility of IT, which in turn leads to effective economic decision making that optimizes resource utilization and the alignment of IT with business strategy. In addition, the use of ABC helps in reducing operational costs.

Expected Value Analysis. It is possible to estimate **expected value (EV)** of future benefits by multiplying the value of each benefit by the probability of its occurrence. For example, an organization might consider investing in a corporate portal only if there is a 50 percent probability that this would result in new business worth $10 million in additional profits and the cost will be less than $5 million. The expected value of this specific benefit would be .5 times $10 million, or $5 million. This method is simple but, like any EV approach, it can be used only for *repetitive investments*.

Unfortunately, none of the above methods is perfect, and it is not simple for organizations to decide which method to use in which case.

IT METRICS

A **metric** is a specific, measurable standard against which actual performance is compared (see our IT performance model at the beginning of this chapter). Metrics can produce very positive results in organizations by driving behavior in a number of ways. Metrics can help to

- Communicate the strategy to the workforce through performance targets
- Increase accountability when metrics are linked to performance-appraisal programs
- Align the objectives of individuals, departments, and divisions to the enterprise's strategic objectives
- Evaluate the performance of IT systems, including Web-based systems
- Assess the health of companies
- Define the value proposition of business models

An example of IT metrics implementation can be found in a white paper that analyzed the impact of a new online service on the profitability of Axon Computertime, a small computer services business in New Zealand. Axon Technologies Corp. (*axontc.com*) lists the following metrics with sample results that were obtained from the implementation of metrics:

- **Revenue growth.** Product revenue increased over 40 percent in the first 12 months of operation.

- **Cost reduction.** Selling costs were reduced by 40 percent for each dollar of margin generated.
- **Cost reduction.** Expenditures on brochure design and production were reduced by 45 percent.
- **Cost avoidance.** Obsolete stock write-offs as percentage of revenue were reduced by 93 percent.
- **Customer fulfillment.** Average days to delivery were reduced by 20 percent over two years.
- **Customer service.** Customer satisfaction with the delivery process is consistently in excess of 80 percent.
- **Customer communications.** Customer response to e-mail communications is five times the response rate to postal mail.

The last few metrics in this list highlight the importance of including nonfinancial measures in the measurement of organizational performance.

Another important metric is the percentage of IT budget within the total corporate budget (*CIO Insight*, 2006).

Metrics, Measurements, and Key Performance Indicators. Metrics need to be defined properly with a clear way to measure them (for a primer, see Smith, 2004). For example, *revenue growth* can be measured in total dollars, in percentage change over time, or in percentage growth as compared to the entire industry. *Cost avoidance*, for example, can be achieved in many ways, one of which may be "decrease obsolete stock write-offs as percentage of revenue." Defining the specific measures is critical; otherwise, what the metrics actually measure may be open to interpretation. Metrics are often expressed in terms of ratios. For example, IT staffing ratios are available at *computereconomics.com*.

The *balanced scorecard method* (see *en.wikipedia.org/wiki/Balanced_scorecard*) uses customer metrics, financial metrics, internal business processes metrics, and learning and growth metrics. Metrics are related to the goals, objectives, vision, and plans of the organization. **Key performance indicators (KPI)**, which are the quantitative expression of critically important metrics (known as *critical success factors*), frequently measure metrics that deal directly with performance (e.g., sales, profits). Frequently, one metric has several KPIs.

Any organization, private or public, can use metrics. Let's look at an example. In Australia, the government of Victoria (*vic.gov.au*) is one of the leaders in exploiting the Internet to provide a one-stop service center called "Do It Online." In the United States, MyCalifornia (*my.ca.gov*) offers many services for the citizens of California. In either case, the metric of "travel and wait time" for the citizens who would otherwise have to visit a physical office justifies the service of renewing driver's licenses.

For a comprehensive library of IT metrics (for fee), see *computereconomics.com*. The *Computer Economics Report* provides a large number of articles on many IT economics-related topics.

Balanced Scorecards and Metrics. The *balanced scorecard* is a method of evaluating the overall health of organizations and projects (including IT projects) by looking at metrics in four areas: finance, customer satisfaction, learning and growth for employees, and internal business processes (Chapter 12, *en.wikipedia.org/wiki/-balanced_scorecard*). It is an advanced method for IT justification, as shown in Table 17.3 (p. 627). Each of the four areas can be defined by organizational goals and corresponding measurable metrics (e.g., see Beasley et al., 2006).

ROI CALCULATORS

Vendors and consulting companies have accumulated quite a bit of experience in developing tools for assessing IT investments (frequently referred to as ROI calculators),

some of which are in the public domain. Many are Excel-based (e.g., see Saibeni, 2008, and *baselinemag.com*).

Nucleus Research, Inc. (NRI; *nucleusresearch.com*), a research and advisory company, uses several ROI calculators in helping businesses evaluate IT investments. A large number of calculators, mostly using Excel, are offered by *Baseline* Magazine for a moderate fee.

ROI calculators for e-services also are available. For instance, Streaming Media, Inc. (*streamingmedia.com*) provides an ROI calculator to measure the costs and benefits of telecommunication bandwidth for videoconferencing, streaming video, and video file servers.

Few organizations have attempted to assess the ROI on e-learning, perhaps because it is so difficult to calculate and justify. However, Learnativity.com (*learnativity.com*) provides resources such as ROI calculators, methodologies, a bibliography, and online communities to support the assessment of e-learning (see *learnativity.com/roi-learning.html*).

ROI calculators also are available from various other companies such as Phoenix Technologies (*phoenix.com*) and Alinean, Inc. (*alinean.com*). An interesting example is that of offshore outsourcing described in *Online Brief 17.3*. For more examples of ROI calculators, see *roi-calc.com, gantrygroup.com*, and *phormion.com*.

The Offering from *Baseline* Magazine. One of the major sources of simple calculators is *Baseline* (*baselinemag.com*). It offers several dozen Excel-based calculators (for free). Examples of calculators it offers include

- How to calculate ROI (*Baseline*, 2006b)
- Figuring the ROI of RFID
- Comparing smart phones and laptops
- The ROI of application performance management
- Figuring out your true TCO
- The ROI of VoIP
- The cost of videoconferencing solutions
- The price of grid computing (see *Nolan*, 2006).

In addition, *Baseline* offers tutorials, guides, statistical data, and more related to these calculators. Such calculators are used in specific areas of IT justification, as described in Section 17.4.

How to Evaluate Proposed IT Projects. *Baseline* Magazine developed simple calculators to assess and prioritize IT proposals and forecast the success of technology projects. One calculator is built upon several criteria, each with its own weight and rating (see Smith, 2008b). The calculator allows the comparison of several projects using a spreadsheet. For every project a success value is allocated (out of 100) for each reason; and for each proposed reason, a risk factor is assessed (from 0 to 5). This allows the calculation of a weighted score for each reason and for each project. The lower the total score, the higher the probability of success. Another calculator lists the top 10 reasons why IT projects fail (Smith, 2008a).

Review Questions

1. List five advanced IT justification methods.
2. Describe the business case approach.
3. What is TCO? What is TBO?
4. How can investment in IT infrastructure be assessed by benchmarks?
5. What is activity-based costing?
6. Define IT metrics and provide three examples of benefits.
7. List some IT metrics.
8. Define ROI calculators and explain their use.

17.4 Examples of IT Project Justification

When large sums of money are involved, or when many projects need to be evaluated, organizations develop their own justification method that may be composed of several of the above methods. One example is IoWA ROI, the minicase at the end of this chapter. Another example is that of American Express *IT at Work 17.1*. Note that some of the projects evaluated in *IT at Work 17.1* are not IT, but the method works for *IT* projects as well.

The methods and tools described in the previous section can be used alone, in combination, or with modifications to justify different IT investments. Here, we provide a few examples of how these methods and tools can be used to justify different types of IT projects.

PROCUREMENT

Procurement encompasses the various processes involved in buying and selling: selecting suppliers, submitting formal requests for goods and services to suppliers, getting approval from buyers, processing purchase orders, fulfilling orders, delivering and receiving items, and processing payments.

Given the diversity of activities involved in procurement or e-procurement, the metrics used to measure the value of using IT and especially e-procurement must reflect how well each process is accomplished. However, the focus on the metrics used will differ for buyers and sellers. For example, *buyers* will be interested in metrics such as how quickly they can locate a seller; *sellers* will be most interested in click-to-release time (i.e., the time that elapsed from when the customer clicked to buy an item online until the warehouse staff had a ticket to pick and pack the order). For examples of e-procurement metrics, see *A Closer Look 17.1*. Setting metrics for e-procurement is especially difficult when procurement is done in B2B exchanges.

CUSTOMER SERVICE AND E-CRM

Customer service and e-CRM (Chapter 10) can be provided in a number of different ways. For example, Lowe's seeks to improve customer service on its Web site (*lowes.com*) by providing a "do it yourself" information portal (e.g., offering infor-

IT at Work 17.1

American Express Uses Project Management Software to Increase ROI

FIN

American Express (*americanexpress.com*) controls its investments with smart software. Amex allocates a large amount of money among many projects in its 10 divisions every year. In the past, it financed projects based not on how they contribute to the company's overall goals but each project's individual merit and which project supporters made "the most noise" (politics). At least 35,000 Excel worksheets kept track of the worldwide investments. Each division (unit) used its own formula to calculate return on investment using different discount rates. There was little control and no standards. Even strategic investments were done in a poor manner.

Introducing the Web-based Investment Optimization System (IOS) enabled the company to automate the process of requesting and allocating investment project money. With IOS, the spreadsheets were uploaded to the SQL server where business analytics software (Chapter 12) read and analyzed them. The improved analysis led to the reallocation of millions of dollars for more optimal investments.

With a return on investment of 2,736.1 percent, the first generation of IOS was the grand-prize winner of the *Baseline* 2005 ROI Leadership Awards (see Hallstrom, 2005). The second generation is a Web-based product built in Microsoft.NET by software maker Solver (*solver.com*). Since 2006, over 800 employees in four business units enter budget requests, forecasting, and other financial data into an online form. The IOS then calculates the information and assigns a risk level to each project. The request passes through a chain of approvers until a final fund allocation decision is made.

Another generation of IOS was introduced in 2006. Larger benefits came when Amex's project-tracking system, which consolidates project results and actual return on investments, was integrated with IOS.

Sources: Compiled from Dignan (2005) and from *solver.com* (accessed July 2008).

For Further Exploration: Can other companies use this approach to evaluate IT investments? What is the benefit of the project-tracking system? Discuss the importance of standards and controls in the system.

A Closer Look 17.1

E-Procurement Metrics

Measuring the success of e-procurement is in many ways similar to measuring the success of the purchasing department. Some direct measures involve the company's ability to secure quality, cost-effective materials and supplies that are delivered on time. The following metrics indicate progress in e-procurement:

- Increased order fulfillment rate
- Increased on-time deliveries
- Decreased number of rejects received from suppliers
- Decreased purchase order processing time
- Decreased prices due to increased supplier visibility and order aggregation
- Decreased ratio of freight costs to purchases

Indirect metrics include minimized costs, such as:

- Reduced inventory costs
- Reduced raw material costs
- Reduced rework costs
- Reduced operating costs
- Reduced freight costs

E-procurement can directly or indirectly affect these metrics. Measuring and monitoring e-procurement activities is crucial to identifying both problematic and successful areas. It provides insight into what an organization is doing right and wrong so that it can pinpoint which activities it needs to investigate and adjust.

The University of Pennsylvania measures e-procurement performance through several metrics, as shown here.

Sources: Compiled from Minahan (2004) and Cisco Systems (2006).

Performance Metric	Description	Sample Metrics
Customer satisfaction	Customer satisfaction and performance surveys	Ease of ordering Ability to find items
Spend management	Utilization of University-authorized buying methods	Dollars spent Percent of purchases
Strategic contracting	Specific and group purchasing contracting activity	Total purchasing contracts
Contract utilization	Preferred contract supplier purchase activity	Percent of total purchase order dollars with preferred contract suppliers
Group purchasing	Group purchasing organization supplier	Total group purchase order dollars purchase activity
E-procurement enablement	Penn Marketplace supplier purchase activity	Total number of marketplace-participating suppliers
Diversity inclusion	Diversity and local community supplier purchase activity	Number of diversity suppliers
Electronic invoicing	EDI purchase order invoice transaction activity	Percent of invoices processed via EDI
Cost savings	Normal cost containment activity	Total cost containment program savings Year-to-date savings
Electronic sourcing	Online formal competitive bidding initiatives	Annual savings by major product category
Supplier rationalization	Strategic supplier rationalization activities	Number of deactivated suppliers and dollar amounts
Transaction audits	Purchasing card utilization audits for e-procurement suppliers	Transaction leakage (amount purchased from participating suppliers outside of e-procurement)
Electronic marketing	Showcase electronic marketing activity	Number of visitors

Sources: Modified from the University of Pennsylvania Web site (*purchasing.upenn.edu/supply-chain/performance-metrics.php*) using authors experience.

mation about how to install a ceiling fan or fix paint problems). Such information may already be available online and the company uses it to train service personnel. EC-based banking sites often add customer value by lowering risks and providing information relating to the last successful log-on and the number of unsuccessful log-on attempts. Online prescription drug companies, such as Medco Health Solutions (*medcohealth.com*), proactively provide information via e-mails on prescription refills and warn consumers of drug recalls.

Recent surveys of e-CRM applications have continued to show mixed payoffs. Only a fraction of companies have demonstrated a significantly positive ROI for their e-CRM investments. What can we learn from those companies that have successfully deployed e-CRM and have extracted significant business value? For answers, look at *Online Brief 17.4*.

The Yankee Group found that e-CRM-based applications are effective only when they are part of a company's overall business plan and not just an IT investment (Kingstone, 2004). The Yankee Group report outlines key e-CRM metrics in three areas: sales, marketing, and service, as shown in Table 17.5. These CRM success metrics can also be viewed as tangible, intangible, and risk-related measures. For instance, revenue per salesperson represents a financial tangible metric; marketing dollars and efficiency metrics are captured in the average time to close a deal with a customer, and the average response time to customers' inquiries. Intangible metrics are captured as customer satisfaction and call quality. Although financial and efficiency measures are also classified as risk measures, risk metrics in the Yankee Group report are captured through the first-call resolution rate and the accuracy of the data entered (listed under the "Service" column of Table 17.5). For a CRM ROI calculator, see *peaksalesconsulting.com/CRM_ROI.htm*. These metrics constitute what is of value to the EC sellers and buyers. For an example of calculations, see the Problem-Solving Activity in Chapter 10.

JUSTIFYING A PORTAL

In making the case for investing in a Web portal, Bisconti (2004) suggests that a business case should be made from the internal and external perspectives of the business. The internal payoff must result in productivity improvements, whereas revenue generation determines the external value. Although several commercial portal development environments are available, large companies may consider building theirs

TABLE 17.5 Key Metrics for Measuring CRM Success

Sales	Marketing	Service
Revenue per sales person; cost per sale made	Marketing dollars as a percentage of revenue	First-call resolution rate
Average sale cycle; average deal size	Average return on marketing	Call quality (as measured by quality monitoring)
Sales representative turnover rate	Total leads generated	Voice service level (by type of call)
New rep ramp time	Average response rate	E-mail service level (by type of e-mail)
Average administrative time/rep	Lead qualification rate	Average speed of answer
Percentage of representatives who achieve quota	Lead close rate	Abandon rate
Average time to close	Percent of marketing collateral used by sales representatives	Average handle time
Average price discount	Change in market penetration	Cost per contact (calls, e-mail)
Percentage of accurate forecasted opportunities	Improved time-to-market; percentage of customer retention	Average call value
Average number of calls to close deal	Number of feedback points	Average close rate
Average number of presentations necessary to close deal	Marketing execution time	Agent turnover
Average number of proposals needed to close the deal	Message close rate	Customer satisfaction
Average win rate	Marketing dollars as a percentage of revenue	Accuracy of data entered (e.g., trouble tickets)

Sources: Compiled from Kingstone (2004), p. 7; Alter (2006); and *teradata.com* (accessed July 2008).

in-house. Bisconti argues that metrics and ROI analysis can serve as a prerequisite to the build-versus-buy decision.

Large companies often have an array of intranet and other information systems; the integration of these systems becomes key to the success of the portal. Thus, the compatibility and flexibility of the portal technology becomes paramount. Bisconti asserts that justification for a portal must focus on *business ROI* as well as *technology ROI*. For examples of ROI of portals, see *Baseline* (2006b) and Sullivan (2004).

ESTIMATION OF ENERGY EFFICIENCY IN IT ENVIRONMENTS

Many companies are going "IT green" (Chapters 1 and 15). There are several ways to do so, and companies are interested in justifying IT investments. Nelson (2008) suggests a five-step process of controlling energy use of servers in small businesses. The five steps are

1. Examine utilization (% busy) and load profile.
2. Collect and calculate load profile data and energy consumption for the current server.
3. Estimate utilization and energy consumption for the proposed server.
4. Relate estimates of step 3 to possible ranges of load levels.
5. Calculate the estimated server power consumption of the proposed server; compare it with that of the existing one. Prepare a justification business case.

JUSTIFYING E-TRAINING PROJECTS

The pervasive use of EC means that knowledge of and the ability to use EC are essential, no matter what kind of work is being done. Whether in a government agency or a multinational corporation, inadequate employee EC and IT skills will undermine the day-to-day functioning of any organization.

End-user training that helps employees acquire or improve their EC and IT skills plays a key role in ensuring the smooth operation of organizations in the information economy. However, such training and retraining can be expensive, slow, and ineffective. Therefore, a large number of organizations are considering e-training (see Chapter 9) to supplement or substitute traditional classroom training.

When comparing e-training and traditional training methods, several factors, most of which are intangible, must be evaluated. Mahapatra and Lai (2005) developed a framework for evaluating end-user training. Table 17.6 shows some of the

TABLE 17.6 Factors to Consider in Evaluating E-Training

Evaluation Level	Evaluator	Factors to Evaluate
Technology	Training provider	• Effectiveness of IT in supporting training-related tasks
		• Ease of use and usefulness of IT-based tools used by training providers, including hardware, software, media, and methodologies
	Trainee	• Delivery and presentation of training materials
		• Ease of use and usefulness of communication tools
Reaction	Trainee	• Relevance of the course to the trainee's job
		• Satisfaction with course content and presentation
		• Quality of instruction
		• Effectiveness of instructor
		• Overall satisfaction with the training experience
Skill acquisition	Trainee	• Knowledge and skill learned
Skill transfer	Trainee	• Ability to autonomously apply the skill learned at work
	Manager	• Effect of the training on the trainee's performance
Organizational effect	Manager	• Effect of the training on organizational goal achievement

Sources: Compiled from Mahapatra and Lai (2005), and Hughes and Atwell (2003).

metrics that may be included in such an evaluation. In executing such a justification, the organization also needs to consider the financial factors of e-training versus traditional training methods.

JUSTIFYING AN INVESTMENT IN MOBILE COMPUTING AND IN RFID

Justifying the cost of mobile computing may be difficult due to cost sharing and intangible benefits. *Baselinemag.com* offers tutorials and several calculators to help companies do the following:

- Calculate the return on the wireless workforce.
- Calculate the return on outsourcing mobile device management.
- Calculate the cost of the wireless networks.

Vendors of wireless and mobile hardware, software, and services offer tutorials and calculators as well (e.g., Symbol Technology—now a Motorola company, Sybase, and Intel). Many medium and large corporations are considering implementing RFID systems to improve their supply chain operations (see Chapters 7 and 10). Although such systems offer many tangible benefits that can be defined, many measures cannot be developed due to the fact that the technology is new and that legal requirements (for privacy protection) are still evolving. For a discussion of RFID justification, see *Online Brief 17.5*, and Pisello (2006). For a fee, *baselinemag.com* offers an RFID justification calculator (see *Baseline*, 2006a).

JUSTIFYING IT SECURITY PROJECTS

More than 85 percent of viruses enter business networks via e-mail. Cleaning up infections is labor intensive, but antivirus scanning is not. ROI calculators are available (e.g., at *baselinemag.com*) to judge the cost of using an expert to decontaminate a system versus the use of software to keep the system virus free (*Keepmedia.com,* 2005).

Employee security training is usually poorly done. Companies tell employees what to do, with little or no time devoted to why specific security rules are in place. ROI calculators are available to estimate the cost for comprehensive training sessions with enough time to explain "why," allowing workers to understand the consequences of ignoring or misusing security procedures. For many examples, data, and studies, see *computereconomics.com*.

CALCULATING THE COST OF THE SARBANES-OXLEY ACT

To comply with the Sarbanes-Oxley Act, your company must document every internal process and external effect that will have an impact on its financial health. That's a pretty thin speculation from which to develop a budget. *Baseline* magazine approaches the problem by breaking down the process into its smallest components. For example, one procedure is the preparation of a quarterly revenue statement from one division. *Baseline* includes a transition period during which the user can analyze the procedure and add steps to make sure each phase is properly documented. For its calculator (for a fee), see *baselinemag.com/article2/0,1397,1631901,00.asp*.

We provide a simple Excel-based example of a calculator in Figure 17.4.

Review Questions

1. List five success factors for e-procurement.
2. List five performance metrics for e-procurement.
3. List three tangible and three intangible benefits of e-CRM.
4. List some metrics that can justify e-training.
5. How is justification of mobile computing done?
6. How is the cost of SOX calculated?

	Part I: Start-Up Cost (first year)	Cost/Unit	Units	Total
	Labor Cost			
A	Number of IT employees			
B	Average salary/employee			
C	Total direct employee cost (A x B)			
D	Management and other overhead (25% of C, estimate = .25 x C)			
E	Other experts involved	8,000	5	40,000
	Training			
	Employees involved in training infrastructure	1,000	45	45,000
	SOX portal			
	Data server			
	Load balancer			
F	Other			
	Software			
	SOX software (if purchased or leased)	12,000	20	240,000
G	SOX workflow, BPM, or other			
H	Other relevant costs			
I	Total start-up cost (D + E + F + G + H)			
	Part II: Annual Operations Cost			
J	Hardware, including electricity			
K	Software (hosted or in-house) per month	5,000	12	60,000
L	Labor (employees)	35,000	2	70,000
M	Labor (overhead) .15 x L			
N	Audit, legal, etc.	60,000	1	60,000
O	Other IT employees	43,000	3	129,000
	Total operations cost/year			
P	(J + K + L + M + N + O)			
U	Total cost (I + P)			

Compare the total cost of doing SOX in-house or outsourcing part of or all activities.

Figure 17.4 Calculating the cost of Sarbanes-Oxley.

17.5 Economic Aspects of IT and Web-Based Systems

THE ECONOMICS OF THE WEB

In the preceding sections, our focus has been on the economics of *the use of IT* in organizations as an enabler. In this section, we turn to the economics of IT *as a product in itself*, rather than in a supporting role.

In 1916, David Sarnoff attempted to persuade his manager that the American Marconi Company should produce inexpensive radio receivers to sell to the consumer market. Others in the company (which subsequently became RCA) opposed the idea because it depended on the development of a radio broadcasting industry. They did not expect such an industry to develop because they could not see how broadcasters could generate revenues by providing a service without any charges to the listeners. The subsequent commercial development of radio, and the even greater success of television, proved that Sarnoff was right. If it is possible to provide a popular service to a large audience at a low cost per person, there will be ways of generating revenues. The only question is, how?

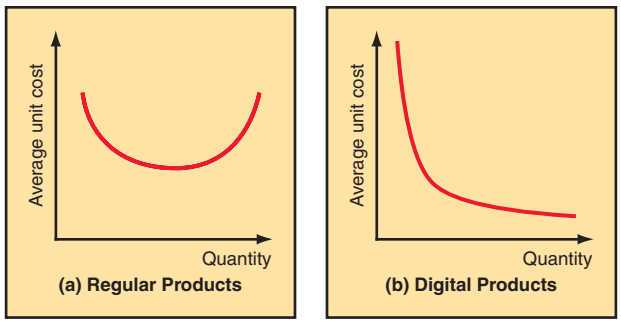


Figure 17.5 Cost curves of regular and digital products.

The World Wide Web on the Internet resembles commercial broadcasting in its early days. Fixed costs—initial investments and production costs—can be high in themselves, but they are low in terms of average cost per potential customer. Let's look at some specifics.

Cost Reduction and Productivity Increase. As indicated throughout this text, IT and especially Web-based systems can considerably increase productivity and profitability. In order to understand the economic logic of this, let us first examine the cost curves of digital products versus nondigital products, as shown in Figure 17.5. As the figure shows, for regular physical products (a), the average per-unit cost declines up to a certain quantity, but then, due to increased overhead (e.g., adding a manager) and marketing costs, the cost will start to increase. For digital products (b), the cost will continue to decline with increased quantity. The variable cost in the case of digital products is very little, so once the fixed cost is covered, an increase in quantity produces a continuous decrease in average cost.

However, even for nondigital products, IT and e-commerce can shift economic curves, as shown in Figure 17.6. The *production function* will decline (from L1 to L2 in part a) since you can get the same quantity with less labor and IT cost. Also, the *transaction cost* for the same quantity (size) will be lower due to computerization (part b). And finally, the administrative cost for the same quantity will also be lower (part c).

Reach versus Richness. Another economic impact of EC is the trade-off between the number of customers a company can reach (called *reach*) and the amount of interactions and information services it can provide to them (*richness*). According to Evans and Wurster (2000), for a given level of cost (resources), there is a trade-off between **reach and richness.** The more customers a company wants to reach, the fewer services it can provide to them. This economic relationship is depicted in Figure 17.7. With EC, the curve can be shifted outward.

MEASURING IT PAYOFFS

The justification of EC applications can be difficult. Usually one needs to prepare a business case, as described earlier in the chapter. A proper business case develops

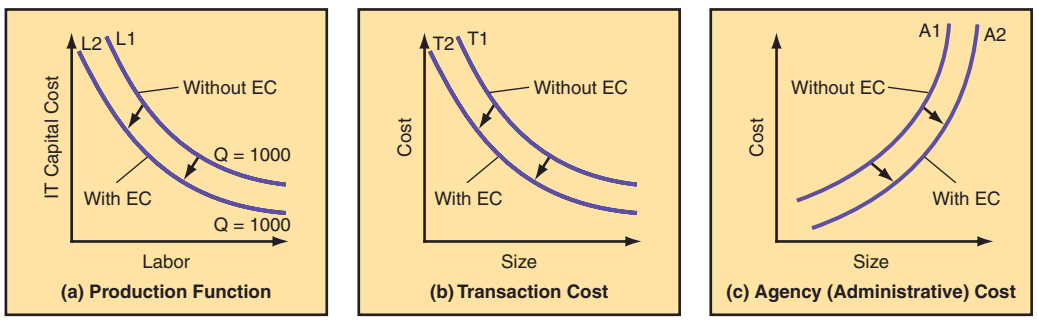


Figure 17.6 Economic effects of IT and e-commerce.

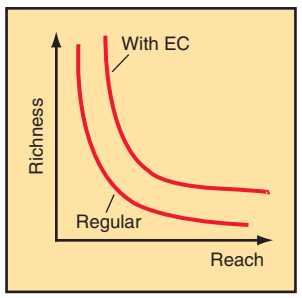


Figure 17.7 Reach versus richness.

the baseline of desired results against which actual performance can and should be measured. The business case should cover both the financial and the nonfinancial performance metrics against which to measure the e-business implementation. For further details on use of metrics to justify e-commerce, see Straub et al. (2002a and 2002b), Tjan (2001), and Turban et al. (2008).

The magnitude of benefits and costs of EC depends on its definitions. But even when the applications are well defined, we still have measurement complexities. It is difficult even to conduct risk analysis, not to mention cost-benefit analysis. (See insights from Thomas Mesenbourg, of the Economic Programs of the U.S. Bureau of the Census, at *census.gov/epdc/www/ebusins.htm*.)

Web-based systems are being implemented by many organizations. However, hardly any efforts are being made to perform cost-benefit analysis or to measure return on investment (ROI) on Web-based systems. Instead, most decisions to invest in Web-based systems are based on the assumption that the investments are needed for strategic reasons and that the expected returns cannot be measured in monetary values. *Online Minicase 17.1* illustrates that some organizations calculate ROIs for their intranets and extranets and others do not.

As indicated earlier, many vendors provide ROI examples, proprietary methodologies, and calculators for IT projects, including EC, such as for portals (e.g., *plumtree.com*). Although use of third-party evaluators, such as IDC Inc., is common, the reported high ROIs should be considered with care. As noted earlier, bias is possible. For a comprehensive discussion of the economics of e-commerce and IT, see Vulkan (2003) and Kohli et al. (2003).

CHARGEBACK

In some organizations, the ISD functions as an unallocated cost center: all expenses go into an overhead account. The problem with this approach is that IT is then a "free good" that has no explicit cost, so there are no incentives to control usage or avoid waste.

A second alternative is called **chargeback** (also known as chargeout or cost recovery). In this approach, all costs of IT are allocated to users as accurately as possible, based on actual costs and usage levels. Accurate allocation sounds desirable in principle, but it can create problems in practice (see *en.wikipedia.org/wiki/Chargeback*). The most accurate measures of use may reflect technological factors that are totally incomprehensible to the user. If fixed costs are allocated on the basis of total usage throughout the organization, which varies from month to month, charges will fluctuate for an individual unit even though its own usage does not change. These considerations can reduce the credibility of the chargeback system.

Nevertheless, organizations can use chargeback systems to influence organizational IT usage in desirable directions. So the way users are charged for these services will influence how much they use them.

Behavior-Oriented Chargeback. An interesting approach is to employ a **behavior-oriented chargeback** system. Such a system sets IT service costs in a way that meets organizational objectives, even though the charges may not correspond to actual costs. The primary objective of this type of system is influencing users' behavior. For

example, it is possible to encourage (or discourage) usage of certain IT resources by assigning lower (or higher) costs. For example, the organization may wish to encourage use of central processing in off-peak hours, and so it might decide to charge business units less for processing from 1 to 4 A.M. than from 9 A.M. to noon.

Although more difficult to develop, a behavior-oriented chargeback system recognizes the importance of IT—and its effective management—to the success of the organization. It not only avoids the unallocated cost center's problem of overuse of "free" resources, but it can also reduce the use of scarce resources where demand exceeds supply, even with fully allocated costs.

There are other methods of chargeback. The reason for the variety of methods is that it is very difficult to approximate costs, especially in companies where multiple independent operating units are sharing a centralized system. Therefore, organizations have developed chargeback methods that make sense to their managers and their particular needs.

IT FAILURES AND "RUNAWAY" PROJECTS

Information technology is difficult to manage and can be costly when things do not go as planned. Indeed, a high proportion of IS development projects either fail completely or fail to meet some of the original targets for features, development time, or cost. Many of these are related to economic issues, such as an incorrect cost-benefit analysis or lack of funding.

Many failures occur in smaller systems that handle internal processes within an organization, and they usually remain corporate secrets. The total investment is not large, the failure does not have a major economic impact, and the effects are generally not visible to outsiders so we do not know about them. On the other hand, some IS failures result in losses in excess of 10 million dollars and may severely damage the organization, as well as generate a lot of negative publicity, as in the Nike case in Chapter 1 or the ERP cases cited in Chapter 10. Failures in large public organizations such as the IRS and Social Security Administration have also been well advertised. A large-scale failure at a university is described in *IT at Work 17.2*.

IT at Work 17.2

A University Accounting System Failed

A large British university (requested to be unnamed) developed a new computer-based accounting system that did not work at all for its first six weeks of operation. Several months later it was evaluated as "failing to do what it was supposed to do" and as "unreliable." This failure led to a major investigation, which concluded that basic project management procedures had not been followed and that it would take at least two years to put things right. A series of smaller oversights and failures led to the catastrophic failure of the system as a whole, because of the interdependent nature of the tasks and responsibilities in the project.

Here are two of the findings of the investigation related to IT justification:

1. **Overspending.** The purchase of new hardware, software, and networks for the accounting system appears to have been planned without any serious attempt to calculate the cost or to identify where the money to pay for it was to come from. This was one reason for the significant overrun of costs for the whole project.

   Lesson learned: There was a failure to budget for the cost of these particular project deliverables. An initial costing should have been part of a business case, which was not done. By presenting a full business case before the project is started, a commitment to resources is obtained from stakeholders and senior management. The construction of a business case also ensures that time is allowed to fully assess costs and benefits of any proposed new system before the project gets underway.

2. **Tendering and contracts.** Consultants seem to have been employed without proper tendering practices being done. It appeared that a contract committing the university to an expenditure of millions of pounds was signed with the database software suppliers without the university having taken legal advice about its contents. Also, no attempt was made to justify the purchases.

   Lesson learned: A university is expected to demonstrate best value for money in the same way as a commercial organization, and this can be demonstrated only if the organization's procurement procedures are adhered to. The procurement process is itself a project to which basic project management principles should be applied.

Sources: Compiled from Laurie (2003) and Saqib (2007).

For Further Exploration: Which of the methods of this chapter could be used for the IT justification? Why are the problems related to project management?

Because of the complexity and associated risks of developing computer systems, some IT managers refuse to develop systems in-house beyond a certain size. The "one, one, ten rule" says not to develop a system if it will take longer than one year, has a budget over one million dollars, and will require more than ten people. Following this strategy, an organization will need to buy rather than develop large systems, or do without them. On the other hand, some organizations believe that if you are large enough, you should not outsource your IT (e.g., see Adams, 2006).

According to *CIO Insight* (2008), the major reasons that IT projects failed are: (1) the business needs have been changed, (2) the project does not deliver what it is supposed to, (3) the problem addressed with IT is not a priority anymore, (4) the cost exceeds the budget, (5) the project does not support the business strategy.

MARKET TRANSFORMATION THROUGH NEW TECHNOLOGIES

In some cases, IT has the potential to completely transform the economics of an industry. For example, until recently the hard-copy encyclopedia business consisted of low-volume sales, primarily to schools and libraries. The physically very bulky product (20–30 volumes) resulted in relatively high manufacturing and shipping costs, which made the price even higher. The high price, the need for periodic updating, and the space required to store the books reduced potential sales to the home market.

Three things happened to change this situation. First, CD-ROM technology was adapted from storing music to storing other digital data, including text and images. Second, since the mid-1990s, use of CD-ROMs has been a standard component of a majority of computers sold for the home market. Encyclopedia producers began selling their products on CD-ROMs, in some cases at reduced prices that reflected the lower production costs. These CD-ROM versions, and now DVDs, include new features made possible by the technology, most notably sound, easy search, and hyperlink cross-references to related material in other sections. Lower prices and additional features have the potential to substantially increase the size of the total market, especially when the encyclopedia is placed online as an electronic book, which is easy to update and requires no shipping cost.

Finally, the encyclopedia industry is now on the Web and available on demand. It includes wikipedia, which is available free online, and its content is provided and maintained by over tens of thousands of volunteers. While some question the quality of the content, others feel that most of the content is of a good quality. The authors of this textbook examined many entries related to IT and found them to be accurate, but not always complete. Other sites provide entry to different types of encyclopedias (some for fee, others for free).

Review Questions

1. How do IT and EC impact cost reduction? How do they impact the production function?
2. Describe reach versus richness in EC/IT environments.
3. Describe measuring IT pay-off issues.
4. Define chargeback and describe why it is an issue.
5. Why do IT projects fail?

17.6 Managerial Issues

Information technology has certain characteristics that differentiate it, and its economics, from other aspects of the organizational world. Therefore IT requires management practices that are more effective than, and in some cases different from, those that are adequate for non-IT activities. For example, organizational resistance to new IT systems on many fronts can turn the most promising system into a failure (Watson and Haley, 1998). Managers need to be aware of and responsive to the following issues.

1. Constant growth and change. The power of the microprocessor chip doubles every two years, while the cost remains constant. This ever-increasing power creates both major opportunities and large threats as its impacts ripple across almost every aspect of the organization and its environment. Managers need to continuously monitor developments in this area to identify new technologies relevant to their organizations and to keep themselves up-to-date on their potential impacts.

2. Shift from tangible to intangible benefits. Few opportunities remain for automation projects that simply replace manual labor with IT on a one-for-one basis. The economic justification of IT applications will increasingly depend on the valuation of intangible benefits, such as increased quality or better customer service. In contrast to calculating cost savings, it is much more difficult to accurately estimate the value of intangible benefits prior to the actual implementation. Managers need to understand and use assessment methods that bring intangible benefits into the decision-making processes for IT investments.

3. Not a sure thing. Although IT offers opportunities for significant improvements in organizational performance, these benefits are not automatic. Managers need to very actively plan and control implementations to increase the return on their IT investments.

4. Chargeback. Users have little incentive to control IT costs if they do not have to pay for them at all. On the other hand, an accounting system may allocate costs fairly accurately to users but discourage exploration of promising new technologies or applications. The solution is to have a chargeback system that has the primary objective of encouraging user behaviors that correspond to organizational objectives.

5. Risk. Investments in IT can be more risky than investments in other areas. Managers need to evaluate the level of risk before committing to IT projects. The general level of management involvement as well as specific management techniques and tools need to be appropriate for the risk of individual projects.

6. How do we measure the value of IT investment? IT investments must be measured against their contribution to business objectives. Such investments will involve direct and indirect costs as well as benefits. The impact of IT on existing processes and systems and their integration must not be ignored. Furthermore, IT must create value for all participants, support or improve existing processes, and supplement rather than replace the human element of transactions. The measurement of IT value should occur against the backdrop of metrics that define business performance and success.

7. Who should conduct a justification? For small projects, the finance department can do the analysis. For a large or complex project, an outside consultant may be advisable.

8. Should we use the ROI calculator provided by a vendor who wants to sell us an IT system? It is always safer to use a calculator from an unbiased source. However, some vendors may provide calculators that better fit with your application.

How *IT* Benefits You

Accounting Major

The accounting department is heavily involved in most of the issues discussed in this chapter. Most important is the costing of IT activities, chargeback, cost-benefit analysis, and computation of ROI, NPV, and other formulas. While some of the data are already in the accounting/finance system, other data need to be collected, collaborating with IS and other departments. Finally, arranging a chargeback system for IT usage is not simple and is certain to occupy the accountant's time.

Finance Major

How much IT to purchase and its costs versus benefits are major areas for finance people to be engaged with. Major economic issues such as buy versus lease and when to replace IT hardware are determined mostly by financial considerations. Most important are the selection of methodologies to assess the investments on various IT projects and infrastructure. Finally, financial considerations are essential in outsourcing decisions. Nonetheless, finance people must understand the relevant nonfinancial factors.

Human Resources Management Major

Outsourcing IT activities relates to personnel levels and required skills. Furthermore, for some IT projects, short-term recruiting may be required. Training in both new software and procedures related to outsourcing are of great importance to HRM personnel. Finally, cost/benefit analysis may involve layoffs, retraining, or recruiting employees. Careful assessment and planning by HRM is critical.

IS Major

Buying, leasing, or replacing hardware and software involve not only financial but also technical considerations. And IS people must work together with both end users and various vendors, some of whom may be in other countries. Finally, economic decisions may impact the skills and required training of the IS staff.

Marketing Major

Economic decisions such as pricing, outsourcing, and make or buy may impact on sales and customer relations. Understanding how such decisions are being made with respect to IT is important for marketing and sales strategies. Also, outsourcing may expedite time-to-market, facilitating marketing efforts.

Operations Management Major

The trade-off between labor and automation is a major concern to POM managers, and so is productivity improvement by technology. Many business processes will be impacted by IT and some will need to be changed to fit vendors' software. POM personnel will have to work with vendors, especially in large-scale outsourcing. Finally, managing large-scale projects that involve IT requires the expertise of POM.

Key Terms

Behavior-oriented chargeback *639*
Benchmarks *627*
Business case *626*
Chargeback *639*
Cost-benefit analysis *617*
Expected value (EV) *629*
Intangible benefits *620*
Key performance indicators (KPI) *630*
Metric *629*
Price-to-performance ratio *615*
Productivity paradox *616*
Reach and richness *638*
Total benefits of ownership (TBO) *627*
Total cost of ownership (TCO) *626*
Transaction costs *622*

Chapter Highlights

(Numbers Refer to Learning Objectives)

1 The power of computer hardware should continue increasing at an exponential rate for at least 10 years, doubling every 18 months, while costs remain at the same levels as before. Also the performance/cost ratio of storage and networks behaves in a similar way.

2 Although organizations have spent tremendous amounts of money on IT, it is difficult to prove that this spending has increased national or industry productivity. The discrepancy between measures of IT investment and measures of output is described as the productivity paradox, and it can be explained.

3 Evaluating IT investment requires finding the total costs of ownership and the total benefits of ownership and subtracting the costs from the benefits. The value of information to an organization should be part of that calculation.

3 The major difficulty in evaluating IT investment is assessing the intangible benefits. Also, some costs are difficult to relate to specific projects.

3 Traditional financial approaches can be used to evaluate IT investment, but in many cases methods such as value analysis, benchmarking, or real-option analysis fit better, especially for investment in infrastructures.

4 Intangible benefits cover many areas ranging from customer satisfaction to deferring IT investments. To include intangible benefits in IT justification, one may attempt to quantify them, to list them as arguments for justification, or to ignore them. Specific methodologies may be useful.

5 The NPV and ROI methods work well with tangible benefits. When intangible benefits are involved, one may try one of the following: value analysis, information economics, benchmarks, management by maxim, real-option valuation, balanced scorecard, and activity-based costing.

6 Chargeback systems may be used to regulate the use of shared information systems. Behavior-oriented chargeback systems, if properly designed, encourage efficient and effective usage of IT resources.

7 Using spreadsheets can facilitate a simple ROI calculation of IT projects. Then deal with the intangibles.

8 EC and IT enable electronic delivery of digital products at very low cost. Also, many nondigital products can be produced and delivered with lower overhead and with less administrative cost.

9 Web-based technologies may be approached differently for conducting cost-benefit analysis, due to their different economic curves, lack of baseline data, frequent changes, and so forth. Modifying existing concepts, such as is done in portfolio selection, is advisable.

Virtual Company Assignment

IT Economics at The Wireless Café

Go to The Wireless Cafés link on the Student Web Site. There you will be asked to analyze some IT economics issues as you think about how the many useful and innovative technologies that could be implemented at the restaurant will fit into its budget.

Instructions for accessing The Wireless Café on the Student Web Site:

1. Go to *wiley.com/college/turban*.
2. Select Turban/Volonino's *Information Technology for Management*, Seventh Edition.
3. Click on Student Resources site, in the toolbar on the left.
4. Click on the link for Virtual Company Web site.
5. Click on Wireless Café.

Questions for Discussion

1. What are the general implications for managers, organizations, and consumers of constantly increasing computer capabilities and declining costs?
2. What are the impacts of exponentially increasing computer hardware power and declining price-to-performance ratios on business production activities and new-product development?
3. Discuss what is necessary in order to achieve productivity gains from IT investments.
4. Why is it more difficult to measure productivity in service industries?
5. Compare and contrast metrics and best practices (see KM in Chapter 10). Give an example of each in an IT environment in a university.
6. Discuss what may happen when an organization does not charge users for IT services.
7. Discuss the relationship between metrics and key performance indicators (KPI).
8. A company is planning a wireless-based CRM system. Almost all of the benefits are intangible. How can you justify the project to top management?
9. What is IT infrastructure, and why is it difficult to justify its cost?
10. Discuss the economic advantages of digital products compared to nondigital ones.
11. Enter *businesscase.com* and find material on ROI analysis. Discuss how ROI is related to a business case.

Exercises and Projects

1. Enter *nucleusresearch.com, ibm.com*, or *acecostanalyzer.com* and view their calculators. Then use a calculator (it is free) and calculate an IT investment of your choice. Explain why this calculator may not be useful for an EC project that has unique intangible cost.
2. A company is considering investing $15 million in a new VoIP project. Operating costs are estimated as $2 million for Years 1 and 2, and $1.5 million per year thereafter. The system is expected to increase revenues by $4 million per year for the first year, and $5 million for each year later. For a period of five years of operation, calculate the NPV. (Use an interest rate of 10 percent.) Explain how the company can use the NPV to compare this project with a competing one using the same funding.
3. Enter *Online Brief 17.3* and examine the sample calculator. Take two other countries that you may be familiar with and enter data into a spreadsheet for a comparison.
4. Enter *ibm.com* and find information about how IBM measures the ROI on WebSphere. Then examine ROI from CIOView Corporation (*cioview.com*). Identify the variables included in the analysis (at both *ibm.com* and *cioview.com*). Prepare a report about the fairness of such a tool.
5. A small business invests $50,000 in robotic equipment. This amount is shown as a negative value in Year 0. Projected cash flows of $20,000 per year in Year 1 through Year 5 result from labor savings, reduced material costs, and tax benefits. The business plans to replace the robots with more modern ones after five years and does not expect them to have any scrap value. The equipment generates a total of $100,000 in savings over five years, or $50,000 more than the original investment. However, a dollar saved in the future is worth less than a dollar invested in the present. If the business estimates its return on investment as 15 percent, then $1.00 should be worth $1.15 in one year, $1.32 after two years with compound interest, and so on. Cash flows are divided by these "discount factors" to estimate what they are worth at present. Calculate the total cash flow after this discounting, and discuss whether the investment can be justified.

Group Assignments and Projects

1. Download the ROI case study "Venda Xerox Document Supplies (Case Study E11)" from the Nucleus Research Web site. Read the Venda Xerox case study. While you are connected to the Internet, click "ROI Help Tutorial" in the NR_Standard_ROI_Tool.xls file and read modules 1 through 4. Enter your assumptions of costs and benefits into the calculator and examine how they impact the overall ROI, payback period, NPV, and average yearly cost of ownership (under the Summary tab).

   Answer the following questions based on the Venda Xerox Document Supplies ROI case study.
   a. What were the key reasons why Xerox developed an EC system?
   b. What were the areas in which Xerox could benefit from EC?
   c. How did Xerox calculate the ROI of the EC system?
2. Each group is assigned to an ROI calculator (e.g., from *baselinemag.com*, *nucleusresearch.com, acecostanalyzer.com*, Oracle, IBM). Each group should prepare a list of the functionalities included and the variables. Make a report that shows the features and limitations of each tool.
3. Enter *alinean.com/AlineanPress_ROITWhitepaper.asp* and other sources in the site, and find information that explains Alinean's approach to measuring return on IT. You can download two free e-books from the site that relate to this chapter. Summarize your findings in a report.

Internet Exercises

1. Enter *solutionmatrix.com* and find information about ROI, metrics, and cost-benefit tools. Prepare a report.
2. Enter *zebra.com* and find their ROI calculators (go to resource library). What analysis do the calculators provide?
3. Enter the Web site of IDC (*idc.com*) and find how they evaluate ROI on intranets, supply chain, and other IT projects.
4. Visit the Web site of Resource Management Systems (*rms.net*) and take the IT Investment Management Approach Assessment Self-Test (*rms.net/self_test.htm*) to compare your organization's IT decision-making process with those of best-practices organizations.
5. Enter *plumtree.com* and see how they conduct ROI on portals. List the major elements of the analysis. Is it biased?
6. Enter *sap.com* and use the casebuilder calculator for a hypothetical (or real) IT project. Write a report on your experience.
7. Enter *searchcio.techtarget.com* and find free ROI analysis tools. Download a tool of your choice and identify its major components. Write a report.
8. Enter *roi-calc.com.* View the demo. Prepare a report for your supervisor about the benefits of this service.
9. Enter *rms.net/indicators*_and_*metrics_r_pim.htm* and find recent material related to IT metrics. Summarize in a report.
10. Enter *peak.salescconsulting.com/crm_roi.htm* or *entellium.com/roi-calculator.asp*, and use their free calculator to examine a CRM project of your choice.
11. Go to *brightidea.com* and look for Webstorm 5.0 (or newer). View its capabilities. Relate the software to the content of this chapter and to social networking.
12. Enter APC.com and find information about the Efficiency Quotient tool. Write a report on how the tool works and its benefits.

Minicase

Justifying IT Investment in the State of Iowa

The Problem

For years there was little planning or justification for IT projects developed by agencies of the state of Iowa. State agencies requested many projects, knowing that they would get only a few. Bargaining, political favors, and pressures brought to bear by individuals, groups, and state employees determined who would get what. As a result, some important projects were not funded, some unimportant ones were funded, and there was very little incentive to save money.

This situation existed in Iowa until 1999, and it exists even today in many other states, countries, counties, cities, and other public institutions. Any agency that needed money in Iowa for an IT project slipped it into its budget request. A good sales pitch would have resulted in approval. But this situation, which cost taxpayers lots of money, changed in 1999 when a request for $22.5 million to fix the Y2K problem was made. This request triggered work that led Iowans to realize that the state government needed a better approach to planning and justifying IT investments.

The Solution

The solution that Iowa chose is an *IT value model*. The basic idea was to promote *performance-based government*, an approach that measures the results of government programs. Using the principles deployed to justify the investment in the Y2K fix, a methodology was developed to measure the value any new IT project would create. The system is based on the return on investment (ROI) financial model, and is known as R.O. Iowa (a play on words). Its principles are described below.

First, new IT investments are paid for primarily from a pot of money called the Pooled Technology Account, which is appropriated by the legislature and is controlled by the state's IT department. Pooling the funds makes budget oversight easier and helps avoid duplication of systems. Second, the IT department reimburses agencies for expenses from this fund only after verifying that they are necessary. If an agency's expenditures are not in line with the project schedule, it's a red flag for auditors that the project could be in trouble.

To support spending decisions, agency managers have to document the *expected costs and benefits* according to a standard set of factors. The score for each factor ranges from 5 to 15 points, for a maximum total score of 100 points. In addition, they must specify metrics related to those factors to justify requests and later to determine the project's success. The scores are based on 10 criteria that are used to determine values. Besides asking for standard financial data, the ROI program also requires agencies to detail their technology requirements and functional needs. This level of detail enforces standards, but it also helps officials identify duplicative expenditures. For example, in 2001 several agencies were proposing to build pieces of an ERP system, such as electronic procurement and human resources management. The IS department suggested that, for less money, the state could deploy a single ERP system that agencies could share. The project, which had an estimated cost of $9.6 million, could easily have cost several times that amount, if agencies were allowed to go it alone.

As noted earlier, once a project is funded, the state scrutinizes agencies' expenses. Agencies have to submit their purchase orders and invoices to the Enterprise Quality Assurance Office for approval before they can be reimbursed.

The Results

The R.O. Iowa system became, by 2002, a national model for documenting value and prioritizing IT investments in the U.S. public sector. In 2002 the program was named the "Best State IT Management Initiative" by the National Association of State CIOs. It saved Iowa taxpayers more than $5 million in less than four years (about 16 percent of the spending on new IT projects).

The process has changed users' behavior as well. For example, during the fiscal-year 2003 budget approval process, agencies asked for 17 IT projects, and were granted only six. For the year 2004 they asked for only four projects, all of which were granted. Also, there is considerable collaboration among agencies and use of cross-functional teams to write applications, so the need to "play games" to get project funding is largely gone. Another improvement is elimination of duplicated systems. Finally, the methodology minimizes politics and political pressures.

The success of R.O. Iowa led to the Iowa Accounting Government Act, which requires establishing similar methodology in all state investments, not just for IT projects.

Source: Compiled from Varon (2003) and *CIO* (2003), and *iowa.gov* (accessed August 2008).

Questions for the Minicase

1. List the major deficiencies of the old method of project funding.
2. How are projects justified under the new method?
3. List the advantages of the new program.
4. What are the possible limitations of the method?

Problem-Solving Activity

The Business Value of Mobile Computing

Note: This activity is designed for a group.

Determining the business value of a mobile computing system for field service representatives of an insurance company is your final assignment in this book.

Allianz Insurance (AIC) is a national insurance company that provides B2B automobile, property, and industrial insurance in major U.S. metropolitan areas. It has 16 field offices that support 450 field inspectors who visit insured sites to conduct inspections and settle insurance claims. About 250 auditors oversee transactions to ensure that the business is running smoothly.

With the current system, inspectors get preliminary property or damage information over the phone. After collecting the information, they make site visits to assess the nature of the customer's needs, return to the office to run the numbers and prepare the paperwork, and then make another on-site appointment to finish the transaction. Inspectors fill out weekly activity logs and audit their transactions to ensure accuracy and high quality of service. Oftentimes, the field inspectors come back to the office only to find out that their next visit is in the same general location that they just returned from.

One major limitation of the current system is that field inspectors must frequently return to the office to consult the volumes of manuals to accurately insure clients or settle claims. Frequent updates of insurance rates and risk estimates and a constant flow of new products have made it impossible for the inspectors to carry these manuals with them.

AIC is considering a mobile computing infrastructure that will enable field inspectors to access online manuals as well as other information necessary to conduct business. The system will also enable the central office to make appointments for the field inspectors as well as conduct mailings and other official business. In other words, the field inspectors will work from a virtual mobile office.

Your Assignments in This Activity:

1. Divide the class into two teams. One team will identify the *costs metrics*—tangible as well as intangible—of the pro-

posed mobile computing system. In determining costs, consider hardware, software, application development, integration with back-office applications, and other implementation costs. The second team will identify the *benefit metrics* of the mobile computing system. The teams should consider productivity, cost reduction, reduced duplication, and so on, when determining benefit metrics.

2. Create a spreadsheet and assign your team's costs and benefits estimates (use estimated data). Share these with the other team for their comments.

3. Each group should identify specific metrics to recommend to AIC so that it can conduct a post-implementation ROI.

Online Resources

More resources and study tools are located on the Student Web Site and on WileyPLUS. You'll find additional chapter materials and useful Web links. In addition, self-quizzes that provide individualized feedback are available for each chapter.

Online Briefs for Chapter 17 are available at wiley.com/college/turban:

17.1 Nucleus Research's ROI Methodology
17.2 Advanced Methods for Evaluating IT Investments
17.3 Computing the Cost of Offshore Outsourcing
17.4 Assessing e-CRM ROI
17.5 The ROI on RFID

Online Minicase for Chapter 17 is available at wiley.com/college/turban:

17.1 How Companies Justify Intranet and Extranet Investments

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